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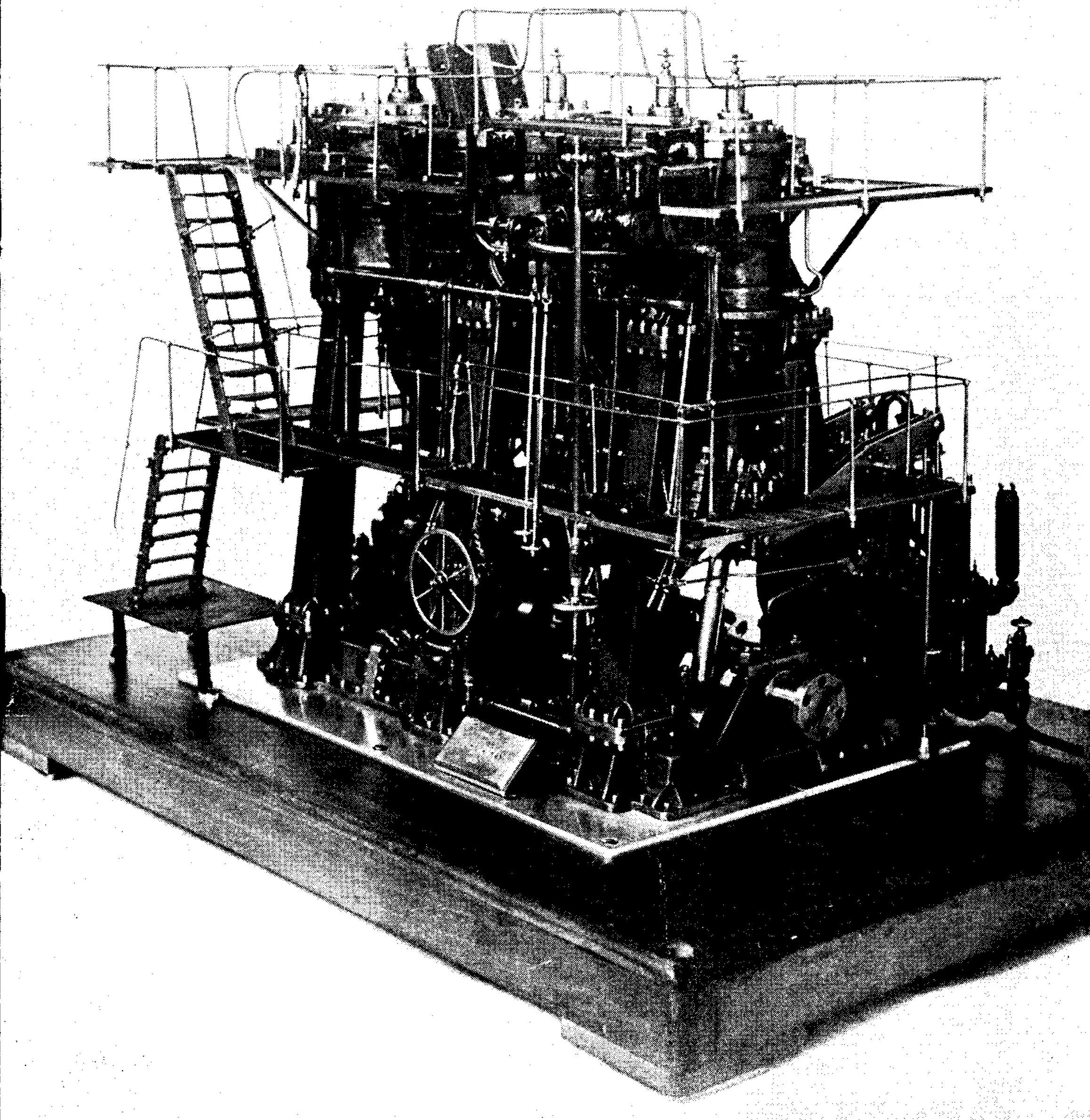
THE MODEL ENGINEER



The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23 GREAT QUEEN ST., LONDON, W.C.2

18TH DECEMBER 1952 VOL. 107 NO. 2691

SMOKE RINGS

Our Cover Picture

● THE MARINE steam engine, in all its forms, and of all periods, offers very good scope for modelling, but in the majority of cases where it is produced in a small size, considerations of available space and practical utility make it necessary to simplify construction as much as possible. Models of large triple-expansion marine engines, with full working detail, are comparatively rare, but some very fine examples of them have been seen at various times at the "M.E." Exhibition, in several cases qualifying for high awards. The set of engines depicted here was entered in the 1948 Exhibition by Mr. J. A. Kay, of Greenford, and won the Championship Cup in the General Models Section. It was again exhibited this year, on loan, among other previous winners of major awards, on the "Celebrity Stand." Incidentally, the Championship Cup in this section, at this year's exhibition, was again won by a marine engine, but in this case it was modelled on a larger scale from a relatively small prototype, namely, a 90 h.p. launch engine, by Mr. A. W. G. Tucker, of Bramhall. A descriptive article on this engine, with some excellent drawings and photographs, is now in preparation, and we hope it will stimulate interest in the construction of a class of mechanical model which is by no means as popular as it deserves to be.

Old Oak Common M.E. Club

● WE HAVE recently received from the hon. secretary, Mr. J. Wiley, some news of the Old Oak Common Model Engineering Club. Considerable developments have clearly taken place since we last heard from this most interesting venture, which Mr. Wiley claims to be unique in so much as it is open to members twenty-four hours a day, all the year round. This gives the members plenty of opportunity for work at their various hobbies.

"I must point out," writes Mr. Wiley, "that the name of the club may be misleading ; although model engineering is the basis of the club, other hobbies, such as fretwork, lamp standards, small scale furniture making, etc., are carried out. Even 'spotting' is given its place.

"At the beginning, the club was for railway workers only, but, owing to pressure from outside, we are now admitting men and women from outside sources.

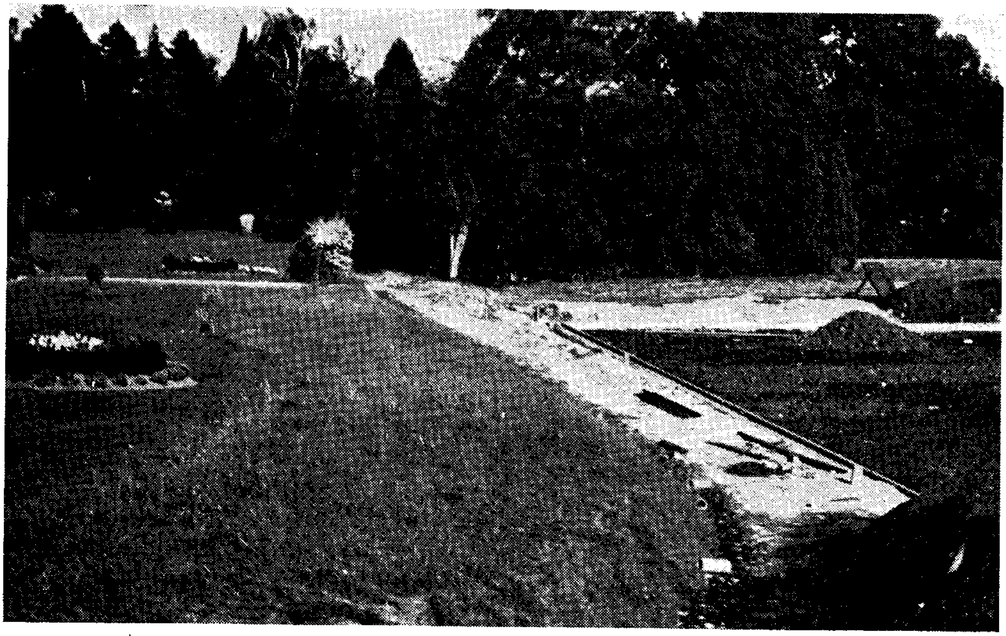
"Some of our recent activities include entering at an arts and crafts exhibition, where we won silver and bronze medals ; lectures on 'Turning in the Lathe' ; film shows and lectures on modelling of all kinds. New members and visitors are welcome to our meetings."

The club is under the chairmanship of our old friend, Mr. F. W. Chubb, and the meetings are held at the Old Oak Common Sheds, British Railways (Western Region). Naturally, members are not free to enter the running-sheds, but are only allowed in the club meeting room and workshop. We understand that the equipment of the latter is progressing very well, and that facilities for most kinds of metalwork and woodwork are available.

Readers requiring further information should get into touch with Mr. J. Wiley, 100, Balham Park Road, Balham, S.W.12.

The Beginnings of a Track

● THE PHOTOGRAPH reproduced on this page was taken recently on the site of the locomotive running track now being built at Beech Hurst, Haywards Heath, Sussex. We have recently published some notes about the formation, aims and objects of the Sussex Miniature Locomotive Society which will build and operate this new track. The layout is roughly pear-shaped and extends to some 1,200 ft. in circumference, making it one of the largest in Britain. Something of the beauty of the site can be seen in the photograph.



Locomotive Headlights

● A READER who signs himself "Progress" has sent us a letter, far too long for publication in its entirety, but raising a question which we thought had "died" years ago. The gist is that "Progress" has returned to this country after a stay of about seven months in America, and has been much struck by the use of very powerful searchlights as locomotive headlights at night in that country. He writes: "I was privileged to travel many miles on the footplates of diesel and steam locomotives at night, and I feel that America has got us 'beaten to a frazzle' in this matter; our puny and old-fashioned, feeble little headlamps seem utterly ridiculous to me now, and I wonder our enginemen put up with them. Have none of our men ever been in a motor-car?"

We think we know exactly what "Progress" will hear if and when he puts this matter to any British engineman! We know our enginemen and a good deal about the conditions in which they work, and we would suggest that "Progress," if he can, should endeavour to arrange for a footplate trip on, say, the "Night Scotsman" from Kings Cross, take very careful note of all he sees, and particularly of all that the enginemen *have* to see, and then try to imagine what it would be like if every train he meets is fitted with a powerful "searchlight" headlamp! A night ride in a motor-car, especially in misty weather, ought to give him a clue. Railway conditions in this country are totally different from those in America, and there are very few places on British Railways where the "searchlight" headlamp would not be an unmitigated nuisance.

On the Grand Scale

● THERE HAS recently appeared a new and prominent landmark in the city of Melbourne, Australia. It is a concrete chimney, 375 ft. high and 16 ft. internal diameter at the top. It was constructed by the Melbourne City Council at their Spencer Street power station, and we understand that it was completed well inside scheduled time.

In conjunction with this chimney, three boilers have been built by John Thompson (Aust.) Pty. Ltd., of Melbourne. One is a controlled circulation boiler suitable for a maximum continuous rating of 300,000 lb. of steam per hour, 620 p.s.i. working pressure at 820 deg. F. final temperature; the other two will each generate 150,000 lb. of steam per hour at 275 p.s.i. and 775 deg. F. final temperature, one being fitted with stokers to burn coke breeze and the other pulverised fuel.

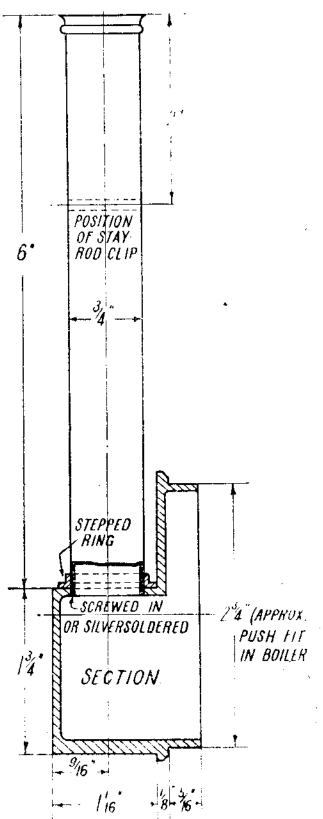
Such vast dimensions make even our little flash-steam boilers fade into utter insignificance! But they show that, in the generation of electricity, steam is not only required in huge quantities, it is holding its own, in the truly great manner.

The "Canterbury Lamb"

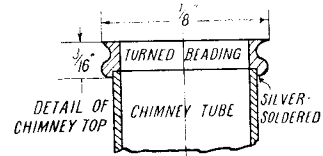
in $3\frac{1}{2}$-in. Gauge

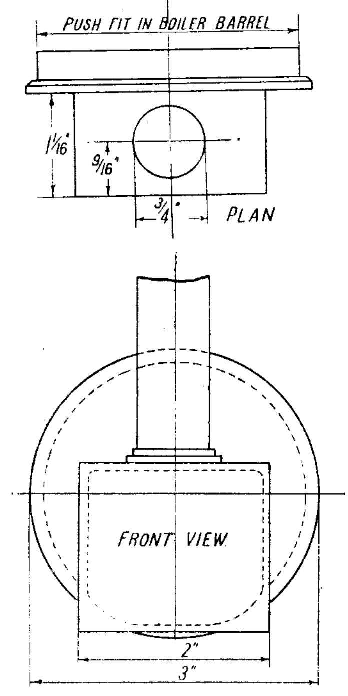
by "L.B.S.C."

THE staying on this little boiler is a very simple job, and is pretty much the same as specified for the smaller of the *Tich* boilers, so there is no need to dilate at length on it. There is one solid longitudinal stay, which should be made of 5/32-in. copper or bronze rod, and furnished with blind nipples, like those recently described for *Britannia's* boiler; but make them from $\frac{5}{16}$-in. hexagon rod, turned down and screwed $\frac{1}{4}$ in. × 40 outside, and drilled No. 30 and tapped 5/32 in. × 40 inside, the stay-rod being screwed to suit. One of the nipples is shown in the longitudinal section of the boiler, published in the last instalment. The hollow stay is made from 5/32-in. × 20-gauge copper tube, and has a blower valve of the usual pattern at the backhead end, and a thoroughfare nipple at the smokebox end. I have detailed out how to make these fittings so many times that I guess most followers of these notes could do the job with their eyes shut. All the dimensions you need are given in the accompanying illustration. When the boiler is erected, an inverted swan-neck of $\frac{1}{8}$-in. copper tube will be attached to the thoroughfare nipple by a $\frac{1}{4}$-in. × 40 union screw, and the jet on the end of it located in the "biscuit-tin" right under the chimney.



Right—How to decorate top of chimney





Cast smokebox front

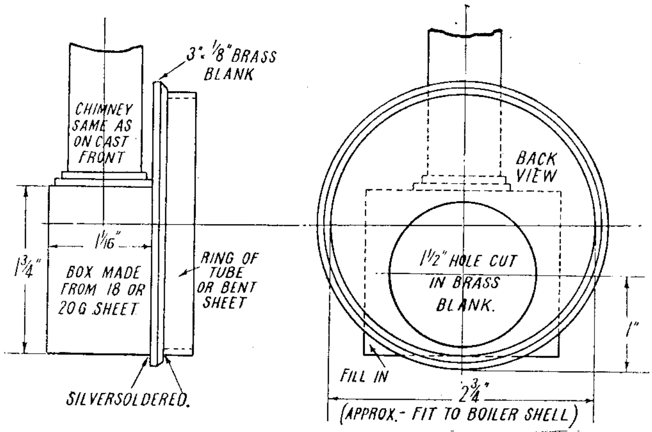
The firebox stays are the same as recently described for *Britannia's* firebox, and are put in the same way, but naturally they aren't so numerous! They are made from $\frac{1}{8}$-in. copper rod, screwed 5 B.A., and furnished with locknuts inside the firebox. There are 12 in each side of the firebox, and 5 in backhead and throatplate, so the job shouldn't take long. When they are all in, sweat over the stayheads and nuts, same as

described for *Britannia*, and then test the little boiler to 160 lb. water pressure, using the rig-up and *modus operandi* as described for *Tich*. If any tears are shed, provide consolation before you go any farther

Smokebox Front

This is one item in which little *Invicta* differs from the old lady who has " stood in the market place " for many years. The ancient dame never had a smokebox worth writing home about ; on her first boiler, the bottom of the chimney was made like a ship's ventilator turned upside down, and the mouth clamped over the tube ends. When she was fitted with the N.B.G. boiler, a glorified biscuit-tin was tacked on to the end, and the chimney fixed on top of it by an angle ring. The poor old girl still has it, but last time I saw her, it looked as though the mice had been at it ; a few more British summers, and the chimney—or what will be left of it—will be standing on lots of nothing ! Anyway, we aren't having any of those larks ; and the illustrations will show how to camouflage a modern smokebox, with super-heater complete, so that " it looks like what it ain't " as a comic song of my childhood days averred. Reminds me of a film star in a crinoline and sun-bonnet ! The actual smokebox is formed by that part of the boiler barrel between the end of same and the tubeplate ; and the front, with tall chimney and " biscuit-tin " all complete, just pushes into the front of it, and kind of " keeps up appearances." My fair lady, when she saw the drawing, said it was a good job they didn't need the sweep, as he would have charged double for a chimney that length !

There are two ways of making the front ; a casting can be used, in which case the " biscuit-tin " will be cast integral with the circular part, and cored out to take the chimney and the blower jet. The front can also be built up by using a stamped brass blank for the circular part, making the " biscuit-tin " from sheet metal, and silver-soldering the whole lot together. Both methods are shown in the illustrations. The chieftain of Clan Mc. Wilwau paid me a visit when he invaded the Sassenach country a short while ago—you should have seen him and the chieftainess doing the knots around my little railway—and I asked him if he could cast the front complete. He said he could, so I expect our other approved advertisers will also be able to do it. Very little machining will be needed ; if a chucking-piece is cast on the front of the " biscuit-tin," centrally with the circular front, it can be held in the three-jaw chuck, and the spigot turned to a tight push fit in the front of the boiler barrel. If no chucking-piece, use the four-jaw. The edge of the circular part can be trued up, faced, and the little bevel formed at the same setting. The " biscuit-tin " itself merely needs filing up ; and you don't have to be particular about a posh finish, either, as the original was a pretty rough job. As I believe I said before, they thought more about " go " than looks, in those days.



Built-up smokebox front

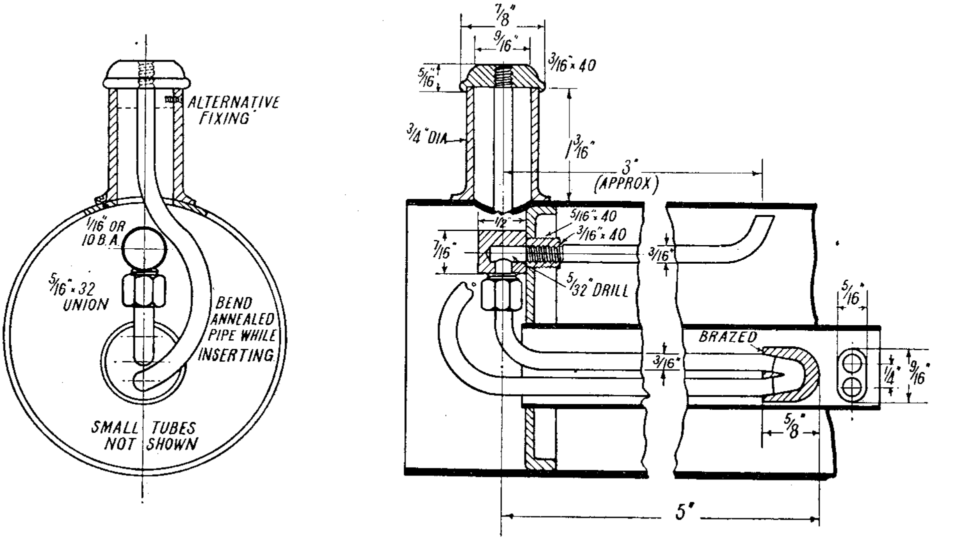
Built-up Front

Those who are inclined to " fabrication," or are far away from the source of casting supplies, can easily build up the front complete, A brass blank, 3 in. diameter and $\frac{1}{8}$ in. thick (commercial article) will make a nobby circular front ; or a disc can be rough-sawn from $\frac{1}{8}$-in. plate. Any metal except aluminium, will do fine. Attach a stub of rod to this, exactly as I specify for chucking smokebox doors, and turn the edge to size if required, also put in the little bevel. At the same setting, mark a ring $2\frac{3}{4}$ in. diameter on the face of the blank, either with a hand graver (you don't see many of these, nowadays !) or a pointed tool set crosswise in the rest. At 1 in. from the edge of the disc, on the centre-line, make a centre-pop ; and from that, strike a circle with your dividers, making it $1\frac{1}{2}$ in. diameter. Cut out the piece ; if you chuck the disc in the four-jaw with the pop-mark running truly, you can cut it out in two wags of a dog's tail, with a parting tool set crosswise in the rest. Alternatively, drill a ring of holes around the line, knock out the piece, and smooth off the raggedness with a file. It doesn't matter a bean if the hole is oval or irregular ; nobody sees it.

The " biscuit-tin " is made in the same way as specified for mechanical lubricator oil tanks, with this difference, viz., the joint shouldn't be on the corner, but in the middle of one of the longer sides. If this is placed underneath, it doesn't show. Cut out a piece of sheet steel about 20 gauge, $7\frac{1}{2}$ in. long and $1\frac{1}{16}$ in. wide. On this, mark a cross line 1 in. from the end, another $1\frac{3}{4}$ in. away, then another 2 in. farther on, and finally another at $1\frac{3}{4}$ in., which will be at 1 in. from the other end. Bend this on the lines, to form a rectangle measuring 2 in. × $1\frac{3}{4}$ in., the joint coming in the middle of one of the longer sides. Secure the joint with a butt strip of the same metal inside, about $\frac{5}{16}$ in. wide, fixing the strip with a couple of $\frac{1}{16}$-in. rivets at each side of the joint. Stand the box on a piece of similar metal measuring about $2\frac{1}{8}$ in. × $1\frac{7}{8}$ in., and braze the joint all around, also the butt joint, using

either soft brass wire, or $\frac{1}{16}$-in. Sifbronze welding wire. Quench in water, and clean the edge around the open end; file the end cover plate flush with the sides.

The next requirement is a piece of $2\frac{3}{4}$-in. tube, about $\frac{5}{16}$ in. wide, to form the spigot that fits the end of the boiler barrel. A ring $2\frac{3}{4}$ in. diameter, bent up from $\frac{5}{16}$-in. strip metal, and a rivet put



Details of the superheater

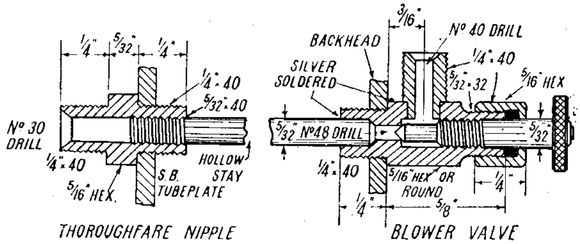
through the lap, would do just as well. This is attached to the brass blank by a couple of bits of angle, to coincide with the scribed circle mentioned above. The "biscuit-tin" is then placed in position on the opposite side, and fixed with a bit of iron binding wire. The whole lot is then silver-soldered at one heat; if best-grade silver-solder, or Easyflo, is used, there won't be any fear of melting the joints of the "biscuit-tin." Make-up pieces of thin metal can be put in the two bottom corners, and silver-soldered, either at the same heat, or separately; the local heat required, won't melt the rest of the job. The spigot should be a tight push fit in the end of the boiler barrel.

Chimney

The chimney is a 6-in. length of $\frac{3}{4}$-in. thin tube; brass, copper or steel. A little ornamental beading is turned to go on the top, see detail sketch which is self-explanatory. It can be turned from $\frac{7}{8}$ in. $\times$ $\frac{1}{8}$ in. tube, or solid rod, or a brass casting, a small rebate being formed under the bead, to take the chimney tube. It should be a tight fit; the joint is silver-soldered. At the bottom, a small stepped ring is needed; this can also be turned up from tube, or whatever is available, and pushed on the chimney about $\frac{1}{8}$ in. from the bottom. Cut a $\frac{3}{4}$ in. hole in the top of the "biscuit-tin," in the position shown in the plan view, and fit the chimney into it. It should be a very tight fit; make sure the chimney isn't "skew-whiff" in relation to the whole front, and see that the angle is in close contact with the top of the "biscuit-tin." The joint can then be silver-soldered; take care to avoid playing the flame on the joints of a built-up front, or you've had it! In the case of a casting, as an alternative, the chimney could be screwed at the bottom with a fine thread, and the hole tapped to suit. The alternative for the built-up front would be to silver-solder the stepped ring to the chimney about $\frac{3}{16}$ in. from the bottom, put a fine thread on the bit below the ring, poke it through a clearing hole in the top of the "biscuit-tin" and secure it with a thin nut inside. There is plenty of room to get at the nut, through the $1\frac{1}{2}$-in. hole.

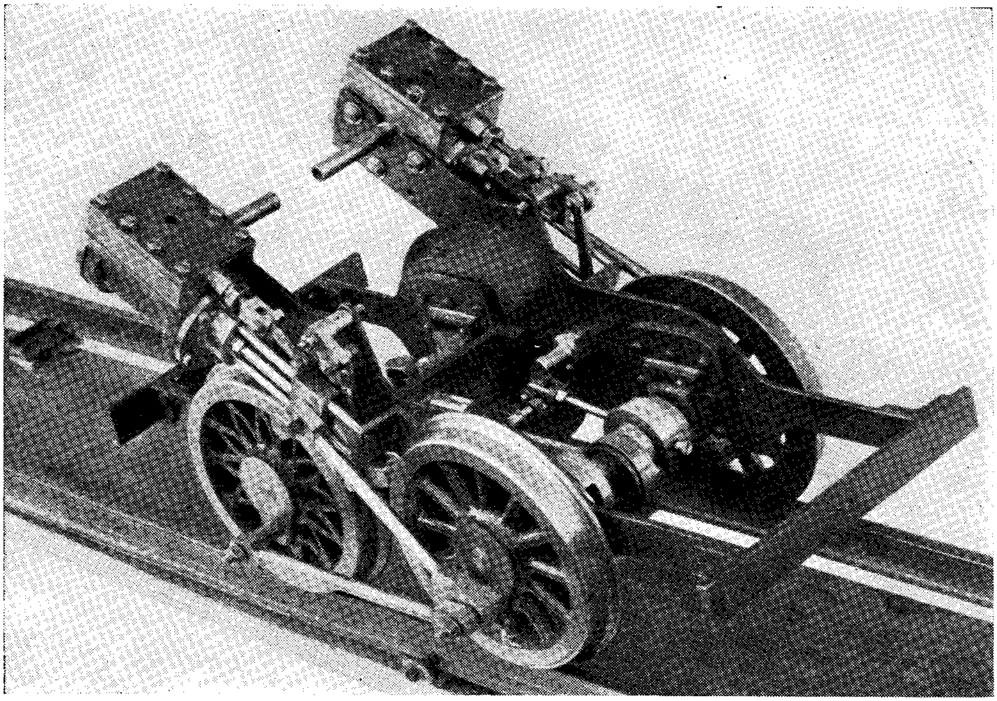
Superheater

The superheater is a simple job, the wet header being merely an elbow with union. To make it, chuck a piece of $\frac{7}{16}$-in. brass rod in the three-jaw; face the end, centre, drill down to $\frac{3}{4}$ in. depth with No. 21 or 5/32-in. drill, and tap $\frac{3}{16}$ in. $\times$ 40. Turn down $\frac{5}{16}$ in. of the end to $\frac{5}{16}$ in. diameter, and screw $\frac{5}{16}$ in. $\times$ 40. Part off at $\frac{1}{2}$ in. from the shoulder. Drill a $\frac{3}{16}$-in. hole halfway along the plain part, into the tapped hole; and in this, silver-solder a $\frac{5}{16}$-in. $\times$ 32



Blower details

union screw ; regular readers should know how to make those all right ! Screw a 3-in. length of $\frac{3}{16}$-in. copper tube into the tapped end of the fitting, and bend up the end as shown, directly opposite to the union screw. The pipe can, if you so desire, be silver-soldered into the elbow, instead of screwed, in a manner somewhat similar to the pipe in the blower valve. Screw right-angles, for attachment to the union screw on the elbow. The other end is bent as shown, to project up through a $\frac{1}{2}$-in. hole drilled in the top of the boiler shell, at 1 in. from the end. It will be a bit of a jerrywangle to get this merchant through ; but if the pipe is well annealed, and gradually coaxed to shape as it is inserted, it can be done without too much trouble.



Mr. S. Reeves gets the cylinders and valve-gear erected

the assembly into the tapped hole in the smokebox tubeplate, with a smear of plumbers' jointing on the threads. When right home, the bend should almost touch the top of the boiler shell, to avoid water going down the pipe.

The elements are made from $\frac{3}{16}$-in. copper tube, about 20 gauge. The upper one (wet side) needs a piece approximately $5\frac{3}{4}$-in. long, one end being furnished with a union nut and cone. The lower one needs about 9 in. of pipe, one end being screwed $\frac{3}{16}$ in. $\times$ 40 for $\frac{1}{4}$ in. length. The plain ends are brazed into a block of copper, which forms the return bend. This is $\frac{5}{8}$ in. long, $\frac{9}{16}$ in. wide, and $\frac{5}{16}$ in. thick. In one of the shorter ends, drill two holes with No. 14 drill, at a slight angle, so that they break into each other inside the block. Round off the plain end as shown, also the top and bottom, to obstruct the flue as little as possible. Lightly file the plain ends of the elements, so that they will just drive in ; then braze them in place, using brass wire or Sifbronze rod. Don't use silver-solder for this end, it is too close to the fire. Brazing or Sifbronzing only needs a bright red heat instead of the dull red that melts silver-solder. Bend the union end at

I don't suppose the bends will pan out as regular in shape as I have drawn them ; but that is only a minor detail ! Inspector Meticulous can't see through the smokebox shell, and as long as they aren't kinked, nor cracked, everything will be O.K. Of course, a running joint, or even another union, could be introduced.

The dome may be turned from a casting, or built up. If a casting is used, it will be in two pieces, body and top. The body is cylindrical, with a flange at the bottom which is saddled to fit the boiler shell, and is a plain turning job. It should have a $\frac{1}{2}$-in. corehole, and this can be cleaned out by holding the round body in three-jaw, and either putting a $\frac{9}{16}$-in. drill through, or boring like a cylinder. The exact size doesn't matter. The casting can then be mounted on a stub mandrel held in three-jaw, and the outside turned to $\frac{3}{4}$-in. diameter, the flange being finished off with a file. The contact side of the flange can be cleaned up with a file, and finished by putting a piece of emery-cloth or similar abrasive, over the boiler shell, and rubbing the concave surface on it.

The dome top can be turned from a casting, or

from $\frac{7}{8}$-in. round brass rod, to the given outline. If the former, chuck in three-jaw by the bead ; face the top, centre, drill through with 5/32-in. or No. 21 drill, and tap $\frac{3}{16}$ in. × 40. Mount on a screwed stub-mandrel held in three-jaw, to turn the outside to the outline shown. If rod is used, chuck, face, centre, drill $\frac{3}{8}$ in. deep with 5/32-in. or No. 21 drill, and tap $\frac{3}{16}$ in. × 40. Turn outside to outline, and part off at $\frac{5}{16}$ in. from the end. In either case, either chuck again by the edge, or on a screwed stub-mandrel held in chuck, and turn a rebate, a bare $\frac{1}{16}$ in. deep, just large enough to fit tightly on the dome body, as shown.

To erect, mount the dome body over the hole where the superheater pipe comes out, and make sure it is quite vertical ; then fix it with three or four $\frac{1}{16}$-in. or 10-B.A. countersunk screws put through clearing holes in the flange, into tapped holes in the boiler shell. Anoint the threads on top of the superheater pipe with a taste of plumbers' jointing ; pull the pipe down, so only $\frac{1}{8}$ in. projects above the cylindrical part of the dome. Then screw the top on to the pipe, so that the latter holds the top down when the body has entered the rebate, as shown in section. It won't come out on its own, because even if the superheater pipe failed to hold it, the steam pipe assembly would teach it good manners, as you'll see when we get that far. However, anybody who cares to take the trouble, could turn the top with a spigot to fit in the dome body, instead of rebating it, and put a couple of 3/32-in. screws in, as shown by the dotted lines. Next stage, boiler fittings.

It is a pleasant surprise to your humble servant to find how popular this little "old iron" has proved. A number of readers are keeping right up to the instructions. Mr. S. Reeves, who sent the reproduced photograph, says that up to time of writing, the "words and music" have produced a perfect harmony. I'll do my best to see that we don't get any discordant notes !

THE TWINS BACK AT WORK

by G. Main

THE many readers of THE MODEL ENGINEER who are traction engine enthusiasts, will, I am sure, remember the articles in Vol. 102, No. 2550 and Vol. 104, No. 2600 that told the story of the Twins—a pair of Fowler ploughing engines, and perhaps wondered rather sadly whether the acetylene-burner had claimed two more victims. I have made many a journey to Warwickshire in search of them but could find no trace. One's luck does change, however, for a short time ago, when returning from one of my week-end "traction" hunts, I came across a pair of ploughing engines standing in a field in Oxfordshire. They were in quite nice condition and after having a good look round I came home with the numbers firmly in mind. They were familiar numbers, but I just couldn't remember why they should be, until going through some back numbers of THE MODEL ENGINEER I came across Mr. Lawrence's article on ploughing engines and the mystery was solved. The Twins were still in existence.

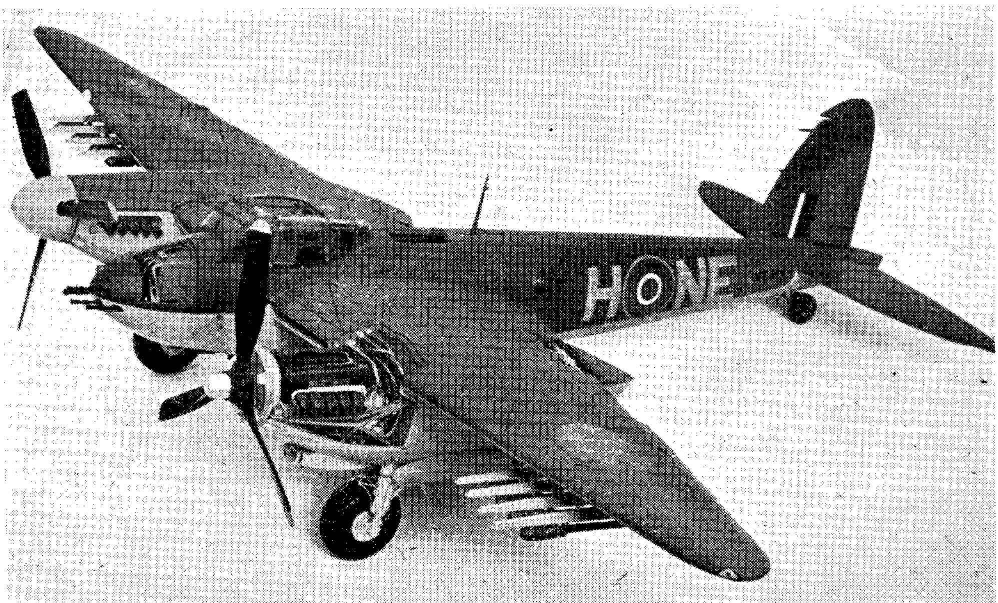
As soon as possible I steered a course back to that field of discoveries, made contact with the owners and learnt the complete story. Fellow traction engine lovers will, I am sure, rejoice to know that the present owners have no intention of scrapping the Twins, being steam men from first to last and having several engines of other types. The engines have been thoroughly looked over, road wheels re-straked, bearings adjusted, tubes attended to, etc., and are now fit for quite a few more years.

The problem of drivers has been got over by training younger men, who, surprisingly enough, take a pride in the engines. Work abounds, for the local farmers are only too glad to be able to get their land treated to good deep cultivating. The writer has spent many happy hours on the footplate watching the rope snake over the ground, smelling the beautiful odour of hot oil and listening to the throaty roar up the chimney. The Twins have been made to speak again, may they long continue to do so.

The end of a hard pull

MODEL AIRCRAFT
at the "M.E." Exhibition
by G. M. Lewis

THE model aircraft competition section at the exhibition this year was most attractively presented and considerably more space was made available to accommodate the increased number of models that were entered. The stand was designed by a modelling enthusiast, student architect Malcolm Young, secretary of the London Area of the Society of Model Aeronautical Engineers, who put to good use his modelling and architectural knowledge and fine fully-detailed model was built to 1/16th scale and was copied from a particular aircraft. Construction was part sectioned to show such details as engines and armament, and all the cowls and inspection hatches were removable as on the prototype machine, and exposed the correct details when they were removed. This model was awarded a silver medal. Another fine model in the same class was a 1/24th scale *Hawker Fury I* made by D. G. Cooksley, a Surrey



This non-flying model of a D.H. Mosquito by R. Livermore was fully detailed

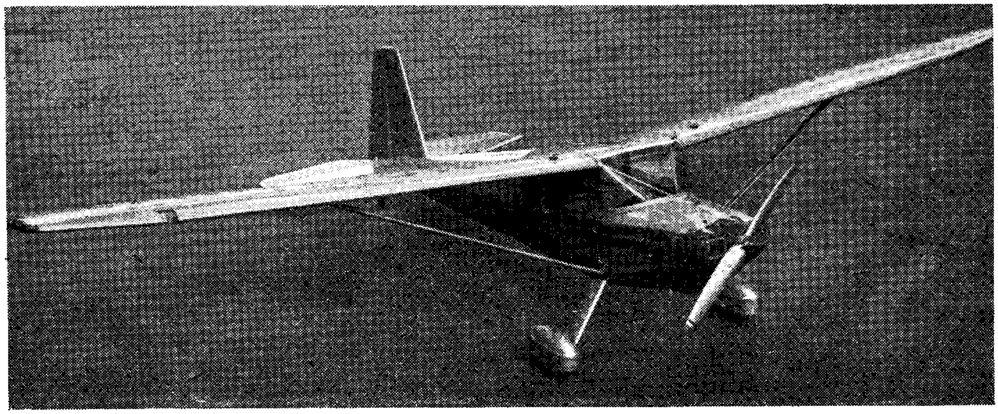
produced an attractive stand for the difficult task of displaying the rather unwieldy models.

By far the greatest number of models were entered in the flying scale classes, and the sections for the models designed purely for contest work were not over-well supported. The standard of construction of the majority of the models exhibited was even higher than in previous years and several models were really outstanding. The advent over the past year or so of really small yet powerful diesel engines has enabled the constructors to completely adhere to the prototype machines in external appearance, and even where the engines are not fully cowled as in some radial-engined types shown, it is possible to make a true-to-scale radial engine with one "real" cylinder surrounded by dummy ones.

The most detailed entry in the non-flying scale section was a *D.H. Mosquito Mk. VI F.B.* by R. Livermore, who is an R.A.F. pilot. This schoolmaster. This model which was in a glass case, was built from aluminium and obeche wood and was fully detailed. The prototype machine copied was the flight leader's aircraft of No. 1 (F) Squadron's aerobatic flight during 1937.

The outstanding model in the free flight scale class was entered by Z. A. Datkiewicz, a member of the Polish Air Forces Model Aircraft Association, and was a 60 in. span (1/9th scale) model of the American *Luscombe Silvair 8-E* aircraft. It was powered by an Elfin 1.49 c.c. diesel engine and was beautifully detailed, even to the point of showing the flush riveting markings with just the right amount of indentation to give a realistic effect. Regrettably, owing to an early misunderstanding about the rules, this model, through no fault of the entrant, had to be withdrawn from the competition.

There were in this section a number of fine models of the "old-time" aircraft; to instance a



Z. Datkiewicz entered this excellent model of a Luscombe Silvair in the flying scale section

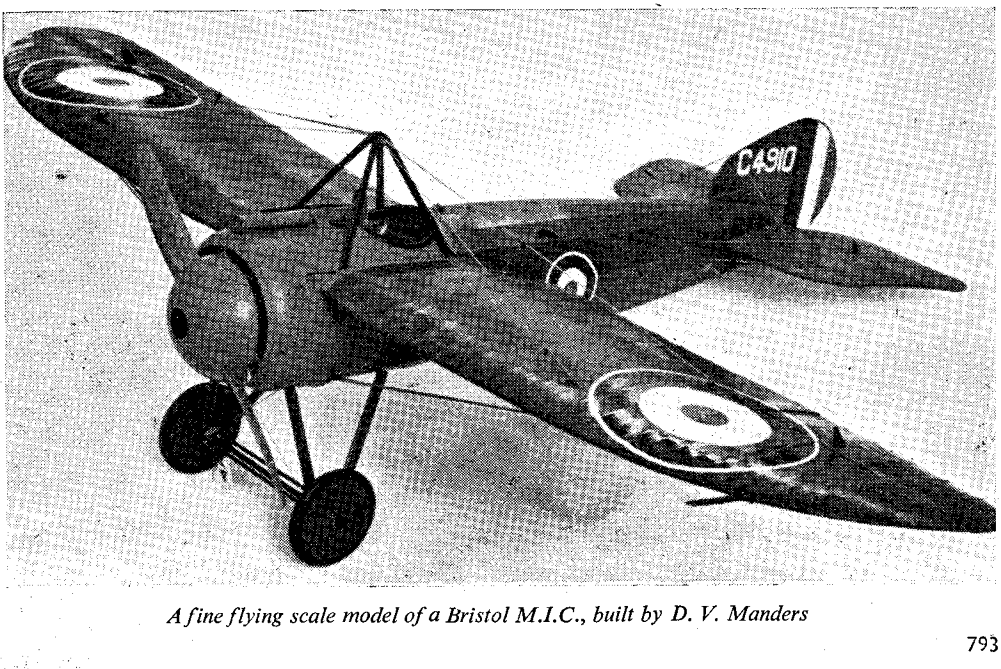
few, a realistic flying model of a Sopwith *Camel* by R. Hutchings, of Beckenham, a Spad S-7 and a Fokker D VII, by E. J. Pithers, and a Bristol M.I.C. by D. V. Manders, the latter model winning the " Bristol " Cup.

On the other end of the scale was a model of the new *Hawker Hunter*, the machine which is now in " super priority " production for the R.A.F. This control-line model is powered by a " Juggernaut " pulse jet and has a wing span of 27 in. This model was made by M. L. Enne, another R.A.F. pilot.

Three other really up-to-date models entered were a free flight Gloster G A-5 *Javelin* powered by a " Jetex 200," by A. J. Shipp, and two neat 1/36th scale solids of the Avro 707a and Fairey F.D.I. delta's entered by B. C. Tichener and B. H. Webb respectively. An ambitious project was the 90 in. span flying scale model of the *Handley Page Heracles* weighing $7\frac{1}{2}$ lb. Built by J. A. Newton, and powered by two E.D. 3.46 c.c. diesels, the model was fitted with a fully detailed interior that could be illuminated. The four dummy " Jupiter " engines were each built from 265 separate pieces.

Among the radio-controlled models was a superb 7 ft. wing span sailplane entered by T. S. Nachtman, also a member of the Polish Air Forces M.A.A. who made this cup-winning model to his own design. The construction and beautiful " natural-wood " finish of this model well justified the high award the judges made.

To sum up, the aircraft section this year, possibly through the later date of the show, was very well supported and produced one of the best displays seen in recent years.



A fine flying scale model of a Bristol M.I.C., built by D. V. Manders

TWIN SISTERS

by J. I. Austen-Walton

Two 5-in. gauge locomotives, exactly alike externally but very different internally

I AM now in the fortunate position of having the "Twin Sister" No. 1, finished, and I was happy to have a chat with some of the other builders at the "M.E." Exhibition. The general imprcssion was that the engine looked much larger than they expected; once the upper works are on, everything seems to fill out in all directions, but in all, it is the final proportions that matter.

In this respect I am able to report that everything went according to plan, and this is the one locomotive that to date, has given me every satisfaction. At the moment she is at the Science Museum, South Kensington, where she will spend the next three months at least.

I do not mind this, as all running weather is now over, and it will enable a few other people to have a look at her in peace and quiet. After this period will come the various running tests, the thoughts of which give me no anxiety at all.

Another thing that gives me peace of mind is the knowledge that all information given to date, has worked out well. Surprisingly few complaints or troubles have come in to me, and the few that have appeared were soon put to rights.

The Hand Brake

In this issue, we have one of the few fittings that go with the chassis itself; this is the hand brake which takes up its position on the right-hand side of the engine, and with its top bearing bracket bolted to the bunker front plate. At the moment, there is no bunker for it to bolt on to, but I suggest you make up the parts as shown and drill the holes in the frames, so that when the time comes you can slip the entire set of works in place.

Taking the vertical brake shaft first, this is made from a piece of $\frac{5}{16}$ in. dia. steel, stainless for preference.

If you dislike the idea of turning away so much metal, you may start off with a piece of $\frac{3}{16}$ in. steel, and braze on to it the collar that forms the thrust face just above the thread. I think "Minor" builders might do this in any case, that is, if they are going to fit this part of the gear at all.

The turning of the shaft is not a difficult job, but watch out when you come to the $\frac{3}{16}$ in. Whitworth thread. This particular thread is, to my mind, the worst specimen that was ever invented; the pitch is coarse and deep. The reason why I chose it for this job was I needed a rapid action with a correct scale outside diameter. I do not, however, leave it in its true form as cut, because it would look quite wrong; but this is the procedure: Do not attempt to cut the thread with a die; ten chances to one it will distort badly—this thread nearly always plays this trick. Set up the lathe for screw-cutting, and hold the shaft truly in a chuck or collet, with just enough projecting for the operation. Allow a little extra length when cutting the rod, and use this extra to provide a very small centre at the bottom end where you are going to cut the thread.

Truncated Threads

When the thread is finished, you may use a die in good condition for final sizing, but this should not be necessary if the right size is obtained direct and tested with a standard nut. Now set up a normal turning tool, and turn down the tops of the threads until you get the general proportions of an acme or square thread. Notice that immediately this is done, the screw takes on an entirely different look and this "truncation," as it is called, does not affect the strength of the thread unless taken to excess. In actual fact, a thread will be stronger than the normal full thread, especially if the form of the cutting tool is not above reproach. The Rolls Royce people, in their Aviation Department, insist on each and every thread being truncated to special limits set down as standard; even the screws holding name plates have to be truncated!

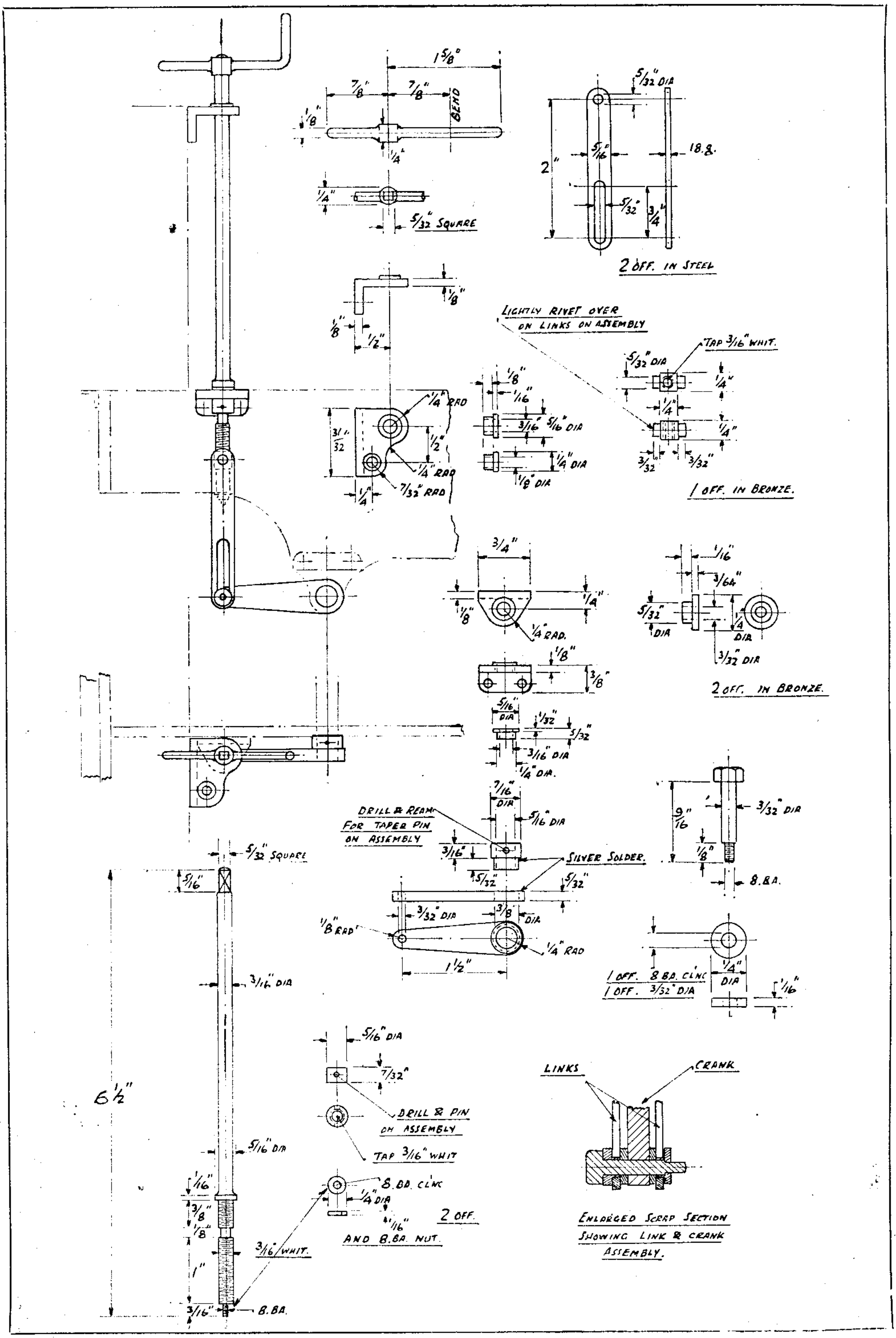
Once the main thread is done, the supporting end may be turned down to take the 8 B.A. thread, and the bit with the temporary centre in it turned away altogether. You will notice that the upper part of the main thread is for the purpose of taking a screwed collar to tie the shaft in its main bearing bracket, the collar being pinned right through, for obvious reasons.

Now make up the main nut that does all the brake application work. Use a good-quality gunmetal for preference, because the two projecting journals have to be lightly riveted over in the slotted links. I would have liked to have had properly nutted ends on these journals, but unfortunately there is so little room between the inside link and the locomotive main frame that it just could not be done; there seemed no point in having the unit riveted on one side and not on the other, so I decided on the method shown.

When you make up the slotted links, you may fix them to the nut for keeps; but just a word of warning: When you start to burr over the journal ends, put a standard screw in the nut portion to prevent this closing up.

When the links are in place, work them about on the nut journals until they become sufficiently free, adding a touch of thin oil in the process. Now run a tap through as a final precaution, after which the nut and links may be put in the box of finished parts. Before leaving this altogether, some readers may want to know why the links

Continued from page 480, "*M.E.*," *October* 9, 1952.



2 OFF. IN STEEL
LIGHTLY RIVET OVER ON LINKS ON ASSEMBLY
TAP 3/16" WHIT.
1 OFF. IN BRONZE.
2 OFF. IN BRONZE.
DRILL & REAM FOR TAPER PIN ON ASSEMBLY
SILVER SOLDER.
1 OFF. 8 BA. CLNC
1 OFF. 3/32" DIA
DRILL & PIN ON ASSEMBLY
TAP 3/16" WHIT
2 OFF.
AND 8 BA. NUT.
LINKS
CRANK
ENLARGED SCRAP SECTION SHOWING LINK & CRANK ASSEMBLY.
5/32" SQUARE
3/16" DIA
5/16" DIA
3/16" WHIT.
8 BA.
6 1/2"

are slotted at their lower ends. This is to allow the steam brake to operate without interfering with the hand-brake mechanism. Obviously, the main crank on the cross shaft will move up and down with the steam brake cylinder working, so regardless of where the brake handle is left, it will work without hindrance.

The Crank

Next on the list is the crank itself. I found I had to dismantle the brake cross shaft, in order to drill for the through pin in the crank boss, but the whole job did not take much more than half-an-hour from start to finish. The arm of the crank is made from plate, 5/32 in. thick, and a turned boss is silver-soldered into it. Make quite sure that the silver-soldering is really secure—brazing might be the better course. A lot of strain comes on this part when the brake is screwed hard on, and that goes for the through pin as well; something a bit better than mild-steel is called for here, and it is worth while turning up a special taper pin for the job. Some little while ago, I was fortunate in picking up a large box full of Brown & Sharp ground taper pins; these are evidently made from some very high-duty steel, and are beautifully finished. I have used these for many jobs, other than locomotive work, and so far, not a single one has failed. If ever you have to remove an ordinary mild-steel pin in the course of normal servicing, you usually find they have "grown in," and get badly mangled up in the process; hardened or toughened pins may be removed repeatedly without much damage, even when driven in really hard initially.

When you come to setting the crank in its position, note that it lies dead at right-angles to the short crank in the middle of the shaft.

The Vertical Brake Shaft

We will go back again now to this component and make up the handle; for a really good job, it should be made from the solid. There is nothing very frightening about this in any case. If my memory serves me right, I think I used a bit of $\frac{3}{8}$ in. stainless steel rod, and turned down the long end first; I then held this in the chuck, and turned down the short end, leaving of course, a bit in the middle that was to become the boss.

This is file work pure and simple, and is worth taking the trouble to get the boss blended in with the two arms.

Now make the square on the shaft; to be absolutely correct, this should have a sight taper so that the handle jams on when given a light tap with a hammer. Later on when the bunker is finished, you will find that you have to thread this down and over the brake shaft, so that a fixed handle would only be a nuisance; in any case, why not make it correct?

File out a square hole in the handle; this, taking everything into account, is much quicker than broaching and will not produce a taper hole anyhow.

There are two brackets to make, one of these has two bushed holes, and it goes up at the top. The other, or vacant hole is for a water valve spindle that makes its appearance later on, so you need not bother more with that yet. The bushes may be either pressed in or silver-soldered. For very short bushes I favour the latter, and for parts that get just occasional wear, the problem of removal for replacement is hardly worth worrying about.

The lower, or step bearing bracket is quite a simple job, but its correct position on the frames is of some importance. A moment's reflection will show you that it ties up the position of the bunker front plate; its position relative to the brake crank is far less important, owing to the fact that this movement is more or less compensating fore and aft, at least to a sixteenth or so.

Having found the position, transfer the holes on to the frames, clamp the bracket in the position found and using the part as a temporary jig, drill through both holes. Even the hand electric drill should cope with this operation, or you might be able to juggle it under the drill press with somebody to help hold the free end.

A Bogey!

Talking about holes in the frames, which is a bogey with most builders who dread having to take the frames apart at the very last moment just in order to fit some forgotten part, here is some glad news. After these two holes just just described, there are just two more 8-B.A. holes to go in the frames, to provide stays for the rear steps, and one large hole in the rear diaphragm for the oil tank. I found that these could all be done with a small drill of sorts, whilst the large hole was in "the clear," and could be tackled under the big drilling machine.

The step bearing bracket may now be mated with the shaft, and the screwed collar set to the correct clearance, and pinned through. For future removal, the whole bracket is unbolted, so that you have the shaft, nut, links, and bottom bearing all in one assembly. The remaining bits hardly need comment. The drawing does show a scrap view of the bottom assembly, mainly to give a clue to the shouldered bushes which enable the through bolt to be tightened right up without binding on the sides of the slotted links.

Finish

Well, the shaft and handle should be bright, and I would prefer to see the main crank and slotted links oil blacked. By that I mean the simple process of heating up the parts to just short of dull red, and plunging in oil to cool. There are difficulties when parts are brazed together, and this is one of those cases. Dull black paint for the crank, therefore, and oil-blacking for the links. My links were in stainless steel which, for your information, will not accept this treatment, so they had to stay bright. Paint is not much use here, as it tends to get scraped off, all along the slot area, and that makes it look worse than awful.

(*To be continued*)

TURNING CONCAVE WORK ON THE FACEPLATE

WHEN the construction of a small hacksaw frame was described recently, it may be remembered that the lengths of $\frac{3}{8}$ in. square material, forming the ends of the frame, were shown hollowed out in order to improve the finish.

When making a batch of components, such as a set of small brake shoes, it is the common practice to machine a metal ring to the correct internal diameter and then to divide the ring into a number of segments. On the other hand, no more than a pair of these fittings may be required or, as in the hacksaw frame, both sides of the material have to be machined hollow. In either case, it will be more economical and will save time if the parts are made from short lengths of bar material.

The machining of the hacksaw components will alone be described, as the method used is equally applicable to other parts of the same kind. A simple drawing should first be made to determine the radius of the curvature, as well as its depth and position on the work.

To illustrate the method of machining employed, the radius will be taken as 2 in., the depth of the hollowing as $\frac{1}{16}$ in., and the centre-line of the curvature as situated $\frac{1}{4}$ in. from the centre of the work. The work-piece is clamped to the faceplate by means of a dog of the kind illustrated in Fig. 1, and, as these clamps are most useful fittings for both faceplate and other work, the opportunity might be taken of making a full set of four, but for the benefit of less experienced readers, the method of construction may form the subject of a future article.

When applying the dog, the nut of the clamp-bolt should be placed at the back of the faceplate, so that the projecting end of the bolt does not interfere with the machining.

Locating the Work

As the present object is to locate the work-pieces so that they can, in turn, be machined to the given dimensions, a setting fixture is attached to the faceplate in accordance with Fig. 2. This fixture consists of a strip (*A*), some $\frac{1}{2}$ in. in width, and an end-stop (*B*).

The strip (*A*) is first bolted to the faceplate with its upper edge lying $2\frac{13}{16}$ in. from the centre of the plate ; this is because, as represented in the drawing, the work-piece is $\frac{3}{8}$ in. in width and the curvature is to be machined $\frac{1}{16}$ in. deep.

When making this setting, by taking the diameter of the faceplate into account, the strip

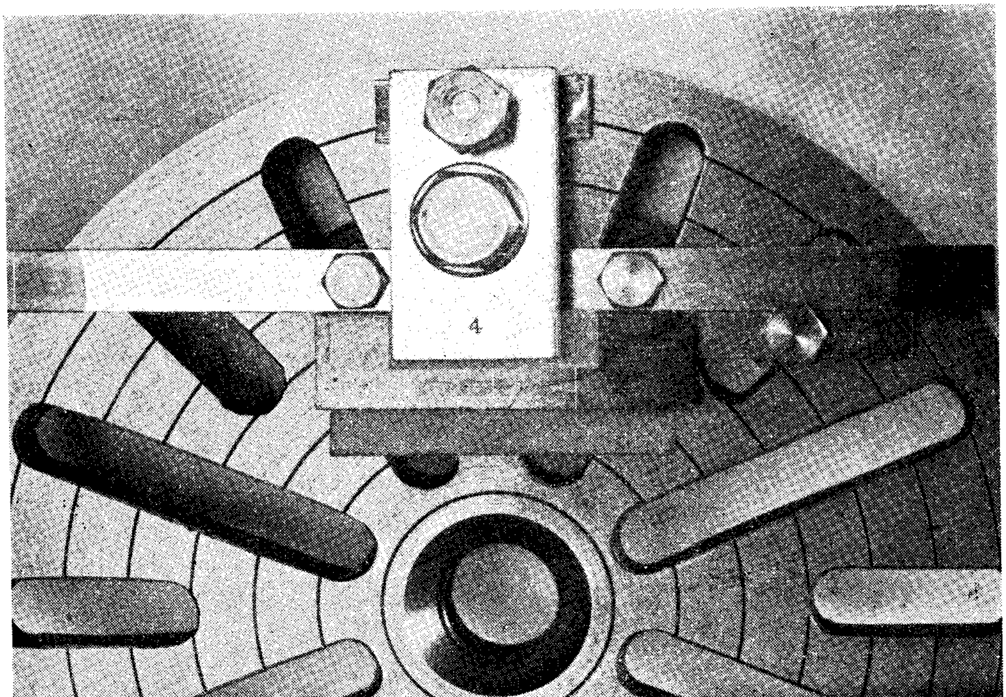


Fig. 1. *The work set up on the faceplate*

can be located from the edge of the plate with the aid of a rule, as shown in Fig. 3. For example, if the diameter of the faceplate is 9 in., the upper surface of the guide strip will lie $1\frac{11}{16}$ in. from the periphery of the plate.

Next, as shown in Fig. 3, the strip is marked

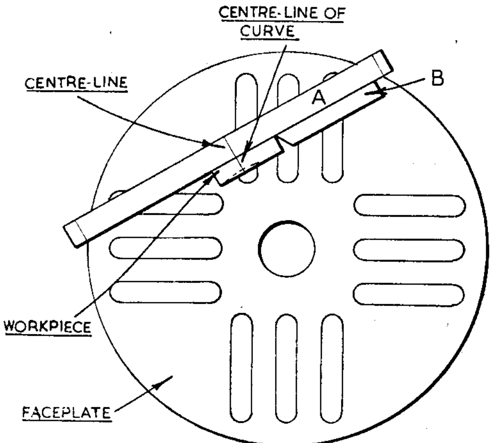


Fig. 2. Showing the position of the guide strip "A," and the end-stop "B."

at either end where it meets the rim of the faceplate, and a centre-line is scribed equidistant from these two marks. The marked-out centre of the curvature on the work-piece is now placed in line with the centre-line of the guide strip, and the work is clamped in this position by means of the faceplate dog ; but a strip of sheet brass should be placed under the work to allow the tool to cut for the full depth without damaging the surface of the faceplate.

To ensure uniformity of machining, and to save having to mark-out the remainder of a batch of similar parts, a small end-stop (*B*) is clamped to the faceplate, as represented in Fig. 2.

Machining the Work

Before starting to machine the work, the assembly is brought into static balance by attaching a counter-weight to the faceplate opposite to the main bulk of the faceplate fittings.

A stiff, knife tool should be used for the machining, as the intermittent cutting is liable to set up vibration in a springy boring tool and leave a poor finish. The finish given to the work will be improved if the tip of the tool is slightly rounded and is finally sharpened on an oilstone.

Next, the index of the cross-slide feed-screw is set to zero, after the tool has been fed outwards so as just to touch the work ; this will enable the depth of cut, amounting to $\frac{1}{16}$ in., to be repeated on the remaning parts.

The lathe can probably be run on the slow, direct speed, but if chatter or running vibration is encountered, the backgear should be engaged. It is advisable to take at least two cuts across the work, and the last should be a light finishing cut of only a few thousandths of an inch in depth.

The finish will be improved if cutting oil is applied to the work, but care must be taken to keep the hands well clear when using a brush to convey oil to rapidly rotating, irregular work.

Where both sides of the component are machined, like those of the hacksaw frame,

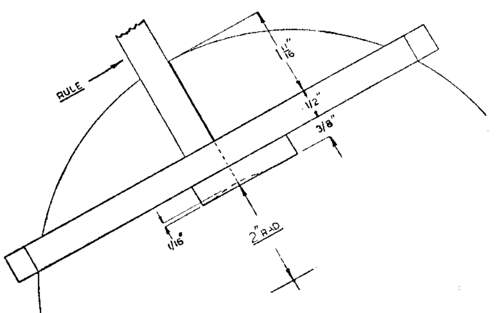


Fig. 3. Setting the guide strip from the edge of the faceplate

the curvature on the second face is cut by turning the part over and again locating it against the guide strip and the end-stop.

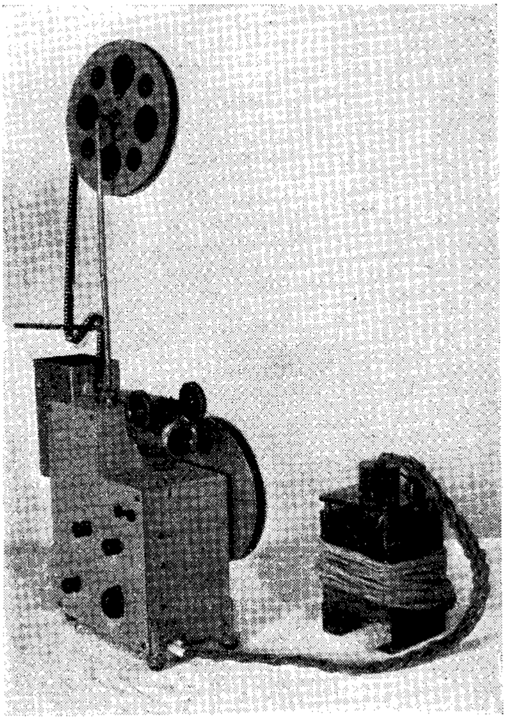
With this simple set-up, there will be no difficulty in machining a batch of components uniformly and, at the same time, either one or both sides of the work can be formed with an identical curvature.

The Moore & Wright Catalogue, No. 52

The latest catalogue issued by Messrs Moore & Wright Ltd., Sheffield, which has recently been submitted to us, contains a full and up-to-date list of the well-known specialities of this firm, including a wide variety of micrometers, gauges and measuring instruments of all kinds, punches, chisels and other hand tools. Special attention is called to a new addition to the range of Spiral Ratchet Screwdriver, No. 851, Heavy Duty type, which is supplied with three blades of different widths. This completes the range of three screwdrivers, the other two being Nos. 849 and 850 for light and medium work respectively. Spare parts of all these can be supplied, and instructions for the servicing and replacement of parts are given with each tool. The catalogue also includes a supplement giving current prices of all items, and can be obtained from tool dealers, or from Messrs. Moore & Wright on receipt of 6d. for postage.

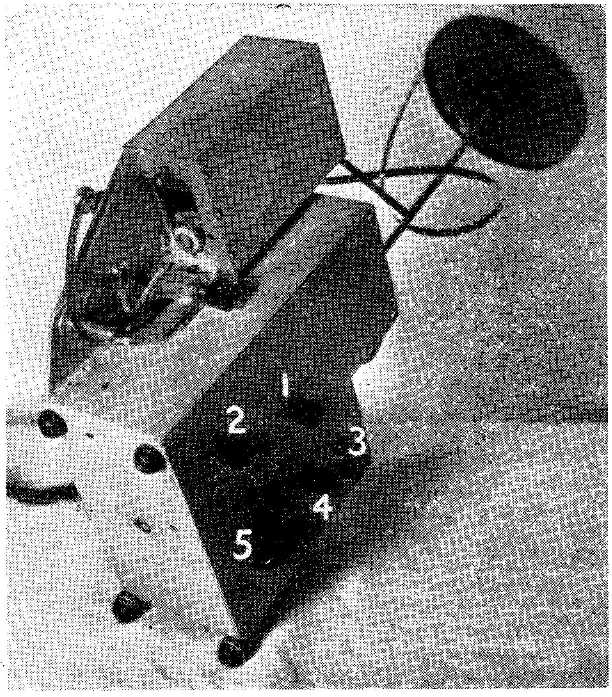
An 8-mm. Cine-Projector

by G. Starre (Holland)



Photograph No. 1. *The cine-projector complete*

THIS projector takes the popular 8 mm. miniature film, and thus when taking films, either double (16 mm.) or single 8 mm. film stock can be used, the double 8 mm. film being run through the camera twice, then split and spliced by the developing agency. The dimensions of the film are given in Fig. 1. The picture field measures 4.5 mm. × 3.6 mm. (0.18 in. × 1.42 in). These dimensions are not so large as the picture-gate of the normal camera, which is, as a rule, 4.8 mm. × 3.8 mm. (0.188 in. × 0.150 in.). The film is carried through the projector by a claw having a stroke of 3.8 mm. or about 0.15 in. To prevent this movement being made obvious, a rotary shutter is utilised. Other features are a still picture device, the absence of sprockets for transport, and a plug connection for a pilot lamp, automatically operated on switching off the projector lamp.

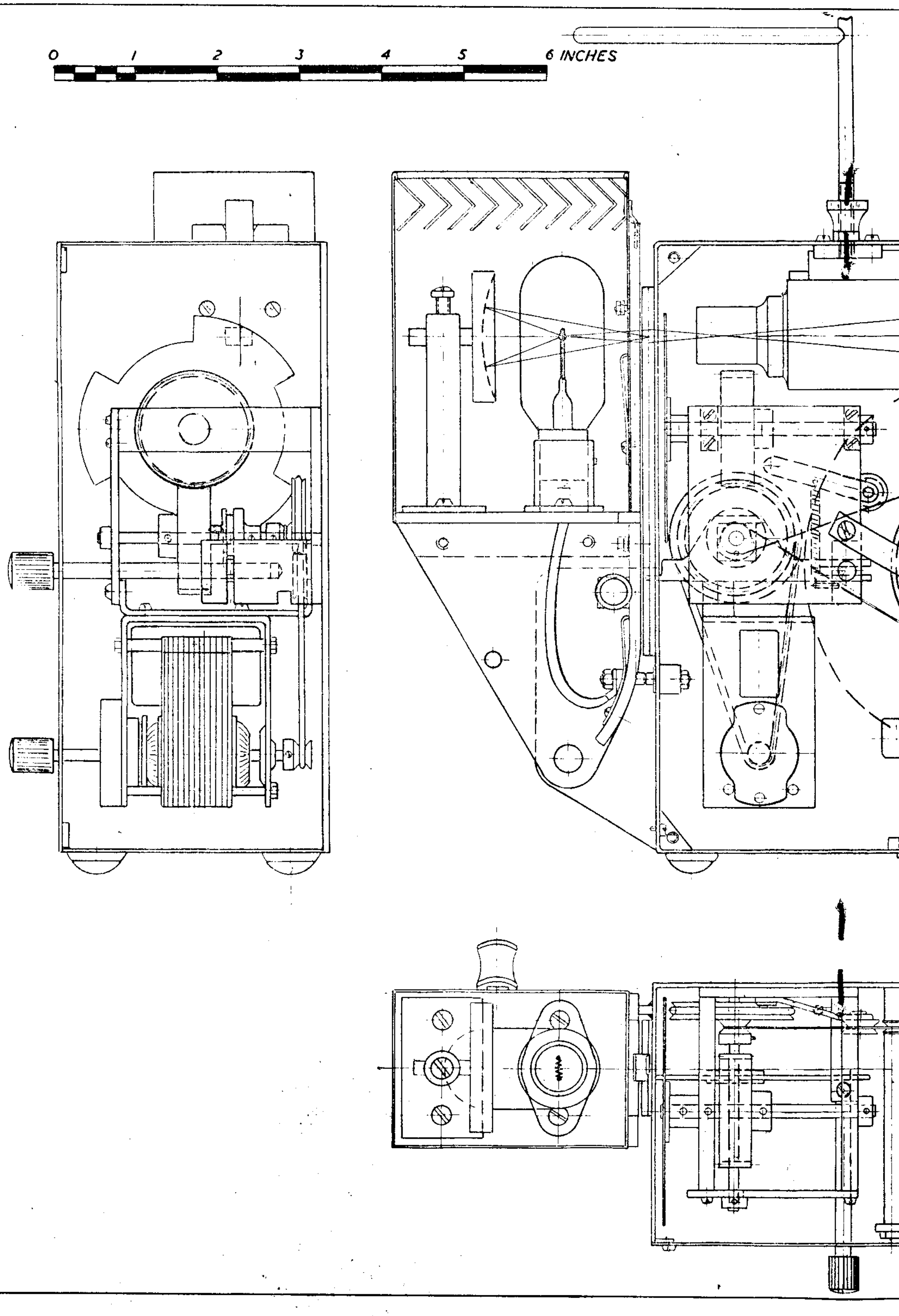


Photograph No. 2. (1) *frame correction* ; (2) *motor shaft* ; (3) *plug-in connection* ; (4) *resistor* ; (5) *main switch*

Details of Mechanism

The transport is effected without sprockets, and the film is moved directly from the supply spool by the claw. To prevent the intermittent motion of the film transport upsetting the supply spool, the irregularity of movement is absorbed by means of the film being hung in a loop around a pin attached to the spool arm. This is shown in Fig. 2. The supply spool has to run very smoothly, and therefore it is mounted on a thin shaft of 0.08 in. diameter. The arm of the supply spool is removable, and also carries the guiding pin for the film loop. As shown in Fig. 3, the film channel itself consists of a groundplate (*A*) on which two separate strips (*B*) are mounted, and between these strips the film passes.

The surfaces on which the film slides must be very smoothly polished,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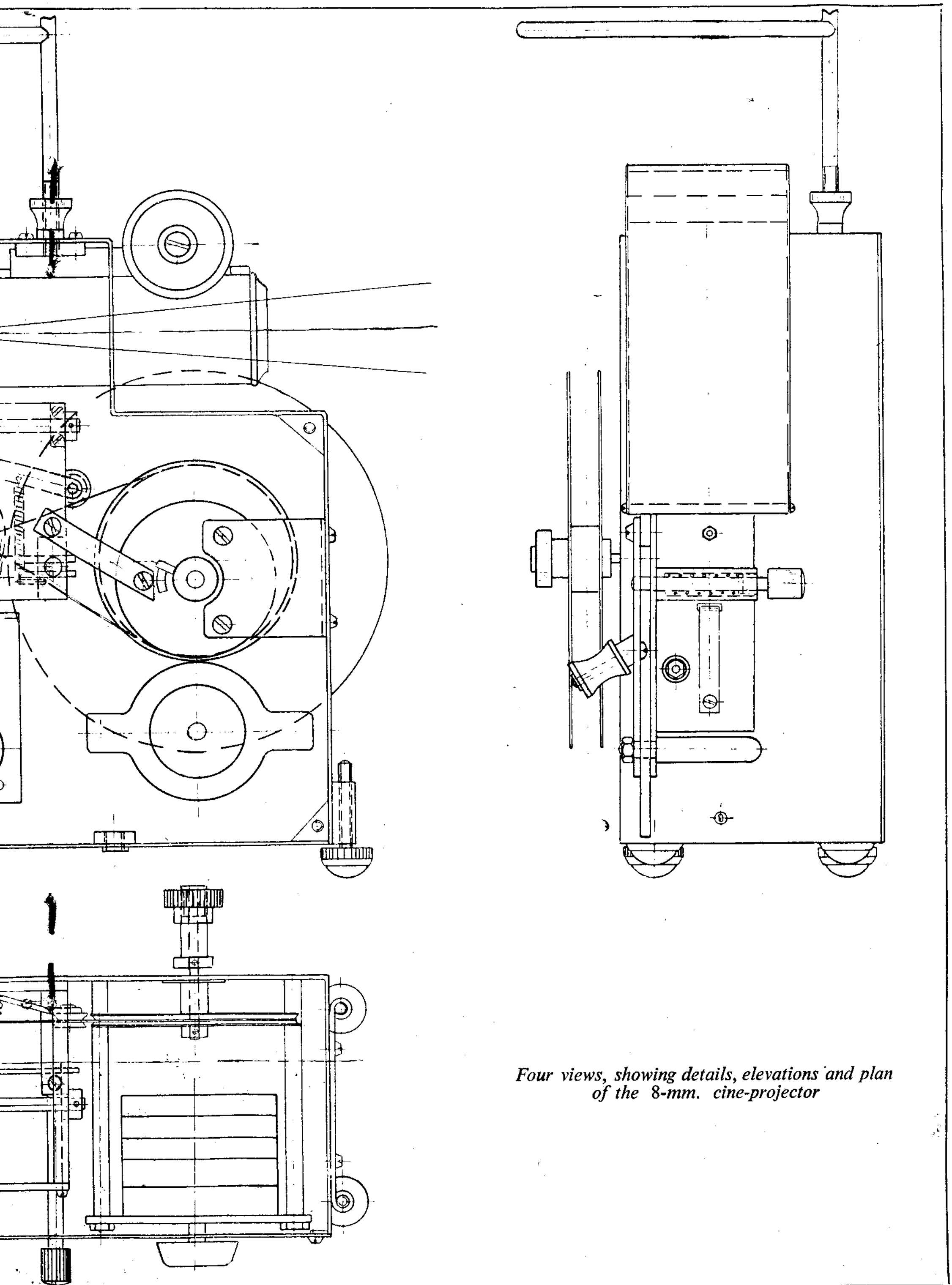


Four views, showing details, elevations and plan of the 8-mm. cine-projector

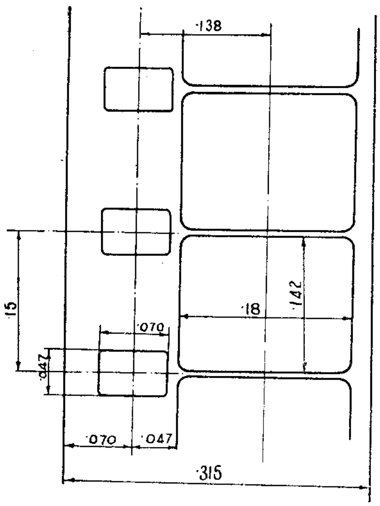


Fig. 1

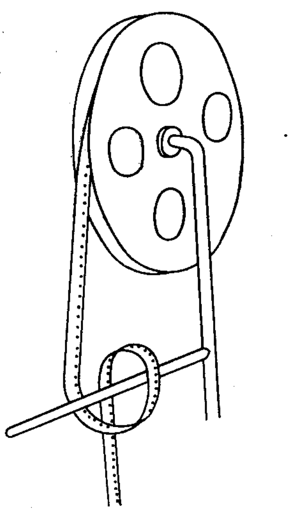
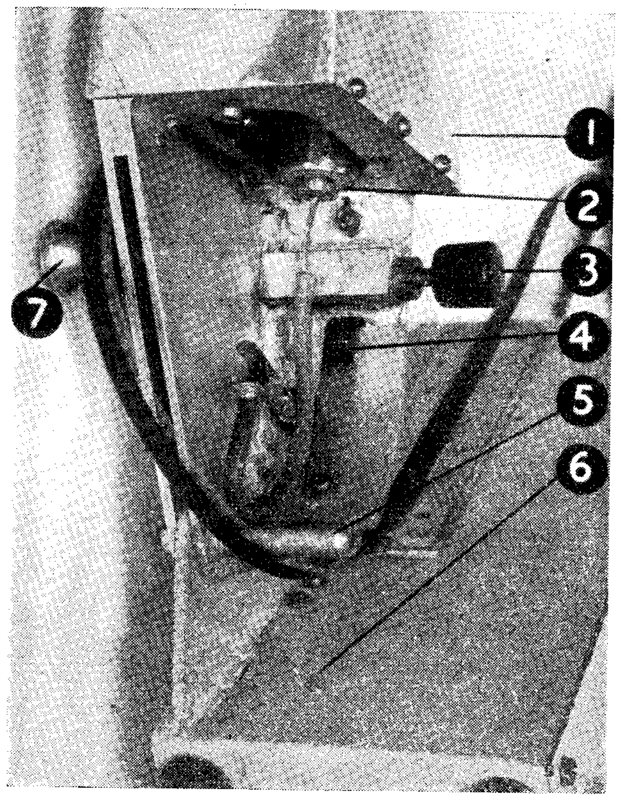


Fig. 2

and the groundplate has a longitudinal groove (shown in Fig. 3) to prevent damage to the picture field of the film when moving along the film-channel. This part of the film is attached to the projector case, as both the groundplate and the projector case have apertures for the passage of the beam of light.

The other part of the film-channel has a movable section. This is shown in Fig. 4. A long strip *A* is pressed against the groundplate by two flat springs, at the upper and lower ends. An aperture is also contained in this, the film pressure plate, which slides into a groove in the strip (*B*) in the frame of the lamphouse, and is also grooved to prevent damage to the film. Nickel plating should be used for all parts of the film-channel, except the groundplate and pressure



Photograph No. 3. *Showing the lamphouse opened.* (1) *lamphouse* ; (2) *lampholder* ; (3) *locking pin* ; (4) *spring on film pressure plate* ; (5) *turning point, lamphouse* ; (6) *pin to fix the film by lay-in operation* ; (7) *guide roller*

plate, for which hard chromium plating is preferable.

The whole lamphouse is hinged on a pin, and located by one plate on the projector case, which

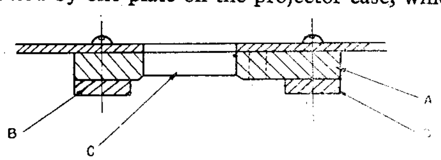


Fig. 3

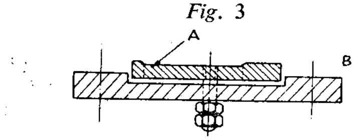


Fig. 4

fits between two plates on the lamphouse. This is shown in photograph No. 3, and ensures effective closing of the film channel A latch pin sliding through the three plates holds the lamphouse in a closed position.

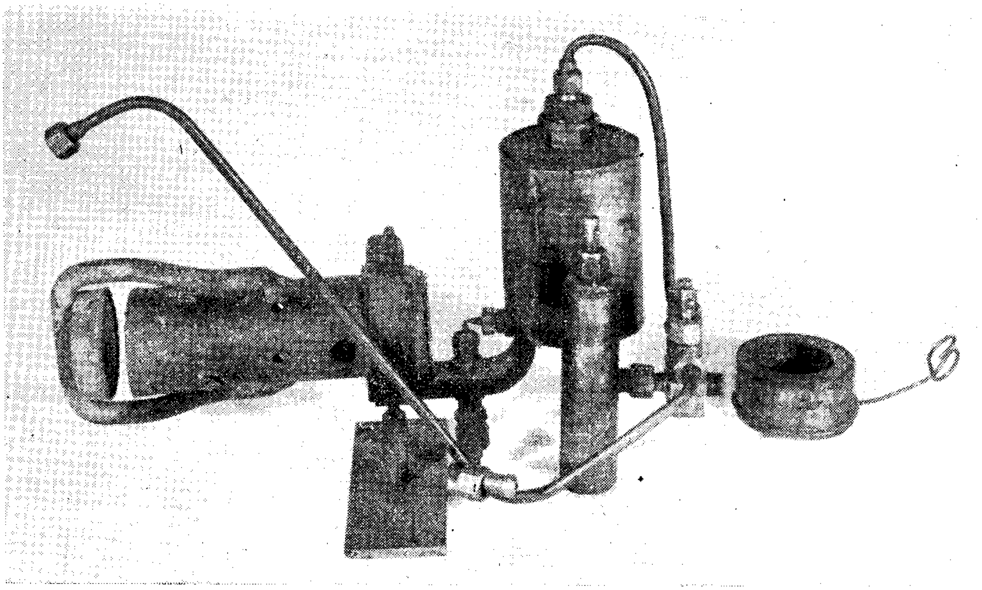
(*To be continued*)

An Automatic Steam Plant

Incorporating feed regulation and an atomising burner

by J. F. Croll

I WILL now describe my burners (Fig. 4), but the research is not complete and is by trial and error. More economical types may be made or better jets prescribed from those with more theoretical knowledge. A piece of $\frac{1}{2}$-in. $\times$ $\frac{3}{16}$-in. steel strip is bent almost to a right-angle with a fairly sharp bend (Fig. 5). The arms should be about 1 in. and 2 in. long. In each arm there is a hole about $\frac{1}{2}$ in. from the inner face of the other arm. The hole in the long arm should be $\frac{3}{8}$ in. and in the short arm $\frac{1}{4}$ in. Both holes should be in the middle of the strip and the $\frac{1}{4}$-in. hole should be filed out until it is $\frac{3}{8}$ in. across the strip. From the edges of the strip, holes should be drilled and tapped into the ends of the $\frac{3}{8}$ in. $\times$ $\frac{1}{4}$-in. slot for the centring screws. I use 10-B.A. on $\frac{1}{16}$-in. welding wire with the ends bent over, but any B.A. size up to 5 or $\frac{1}{8}$-in. Whitworth will do. At the end of the long arm a $\frac{1}{4}$-in. hole is drilled for a stud to hold the burner to any kind of bracket on its outer end and to carry the flame tube on the other end. This completes the frame. To carry the fuel jet a $\frac{3}{8}$-in. bush (Fig. 6) is turned from $\frac{1}{2}$-in. hex. brass, leaving $\frac{1}{8}$-in. of hex., $\frac{1}{8}$-in. of plain $\frac{3}{8}$ in. diameter and $\frac{1}{8}$ in. of $\frac{3}{8}$ in. thread 40 per in., the bush is tapped internally $\frac{1}{4}$ in. $\times$ 40 and a $\frac{3}{8}$-in. $\times$ 40 nut is made a tight fit on the end. This is put in the $\frac{3}{8}$-in. frame hole and the nut forced up until the bush can just be turned smoothly with a spanner. This stops rock and movement due to vibration but the bush must be a good fit in the hole or side play will make mixture adjustment erratic. The fuel jet carrier is $\frac{3}{8}$-in. hex. turned to $\frac{1}{4}$ in. $\times$ 40 for $\frac{3}{4}$ in. at one end and for $\frac{1}{4}$ in. at the other, leaving $\frac{1}{4}$ in. of hex. between. A 5/32-in. hole is run right through and a cone seat made for the pipe nipple on the short end and the other is tapped $\frac{3}{16}$ in. $\times$ 40 for $\frac{3}{16}$ in. depth. This is screwed easily into the bush in the frame, and a little clamp of two pieces of $\frac{3}{16}$ in. square metal (Fig. 7) held by a small screw in the middle is placed so that it grips the fixing stud at one end and the hexagon of the fuel jet carrier at the other. Now, as the inner member cannot turn, it must rise or fall as the bush is turned and thus the height of the fuel jet can be controlled. No bush is used for the steam jet carrier, which is located in the frame by two nuts. Externally it is similar to the one for fuel, internally it is tapped $\frac{3}{16}$ in. for $\frac{1}{8}$ in. depth and a $\frac{1}{16}$ in. hole is



Photograph No. 4. The atomising burner, donkey boiler and lamp. Both float chamber and pressure gauge are removed. Being an early type, the fuel jet is adjusted by lock-nuts

Continued from page 782, "*M.E.*," *December* 11, 1952.

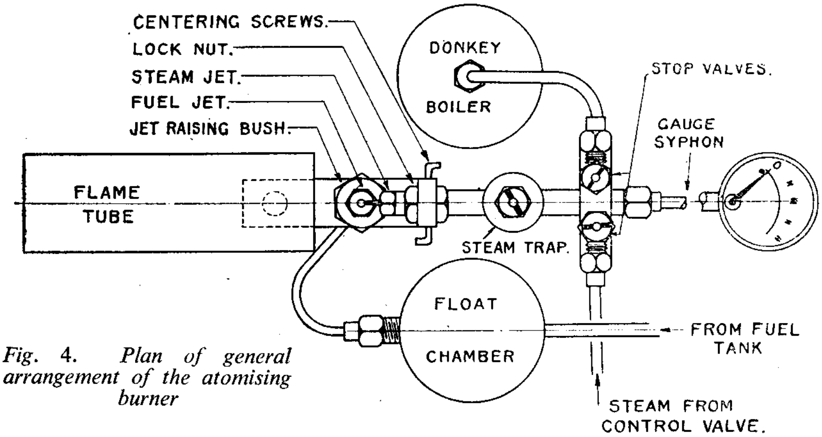


Fig. 4. Plan of general arrangement of the atomising burner

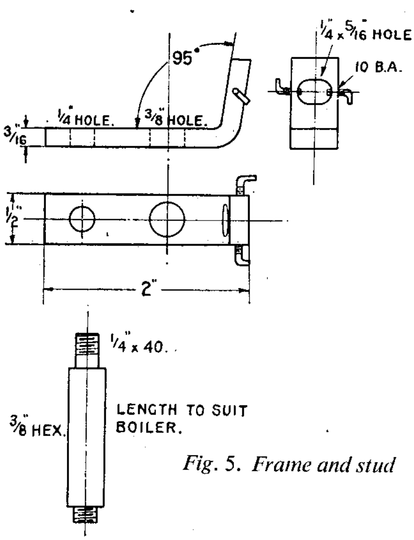


Fig. 5. Frame and stud

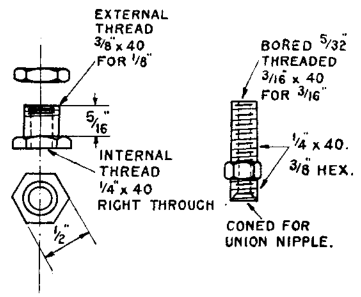


Fig. 6. Fuel jet carrier and raising bush

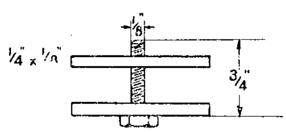


Fig. 7. Clamp

drilled through. Now this is one of the fussy points demanded by steam but not by air. When the steam leaves the water separator no change of bore diameter must provide a gathering place for condensation. The bore must be smooth until it tapers in the jet, or blobs of water will grow until forced to the jet, where the momentary break caused by their passage to the steam flow will extinguish the burner.

Behind the steam jet carrier is the water separator or steam trap (Fig. 8). A 2 in. length of $\frac{1}{2}$-in. bore copper or brass is plugged at the bottom leaving a $\frac{1}{16}$-in. hole in the centre. At the top, the plug is tapped for a $\frac{3}{16}$-in. needle valve which seats in the bottom hole at the other end. A gland of some sort is advisable. Anywhere in the top half a $\frac{1}{4}$-in. $\times$ 40 hole should be drilled and tapped for the steam jet carrier and diametrically opposite a nipple for the steam inlet pipe, but near the bottom another nipple may be attached at any point for a pressure gauge syphon. When all plugs, nipples and the gland are ready, a touch of silver-solder on each will make steam tight, as pressures up to full boiler output may be used. Two samples of the trap described have worked well but the location of the connections is left to suit the plant with the general proviso that the inlet should be as low and the outlet as high as possible. On no account may the gauge be attached between trap and jet, as every reduction in pressure will discharge a drop of water from the gauge to extinguish the flame. A $\frac{1}{8}$ in. needle valve will work but the larger size makes a bigger baffle between inlet and outlet. Set permanently at half a turn open the trap is big enough to hold the initial rush of condensate until rising pressure blows it out. If more than 40lb. of steam is used, waste may require closing of the valve to $\frac{1}{4}$ or $\frac{1}{8}$ turn but on reduction of pressure to unit figures the needle should be opened to at least the half turn again.

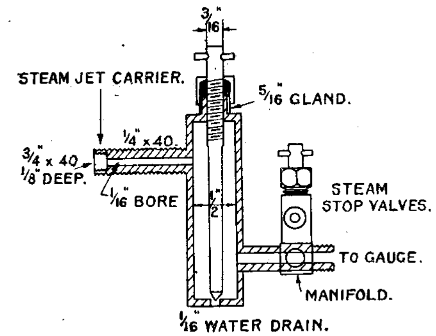


Fig. 8. *Steam trap and water separator*

The flame tube is not fussy and from 2 in. to 6 in. of 1 in. steel or brass tube or a rolled up piece of sheet metal of 21-gauge or thicker will do. I used 1-in. conduit with a $\frac{1}{4}$-in. $\times$ 40 hole centre $\frac{3}{8}$ in. from the end and screwed the burner securing stud of $\frac{3}{8}$-in. rod reduced to $\frac{1}{4}$ in. and screwed 40 t.p.i. through the clearance hole in the frame in to the flame tube, thus securing two parts with one screw, to paraphrase a common expression (Fig. 9). If the burner is to be used with boilers requiring short spread flame, the end may be fishtailed or an arrestor plate may be positioned from $\frac{1}{8}$ in. to $\frac{1}{2}$ in. from the end to cause a flat circular flame very suitable for boilers with cylindrical flues of less than 6 in. length. The tube may even be plugged and drilled to

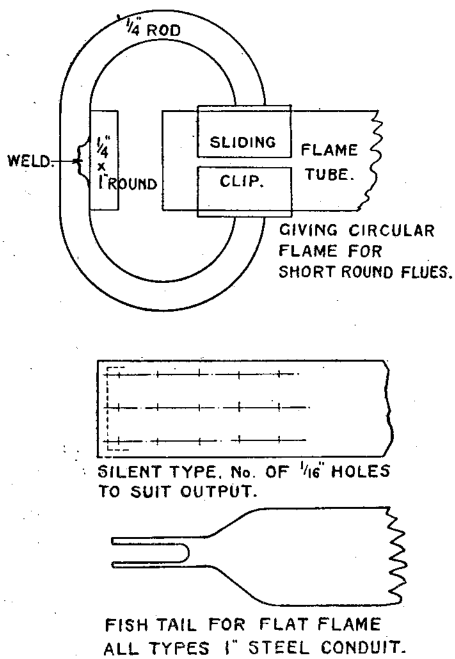


Fig. 9. *Flame tube alternatives*

resemble a gas poker. If it is desired to burn only outside, the holes should be not more than $\frac{1}{16}$ in. diameter the number to give an area of $1\frac{1}{2}$ to twice the cross section of the tube. This arrangement will give a silent flame. A double turn of iron wire gauze will give a similar effect if it extends $\frac{1}{2}$ in. beyond the tube and the end is plugged.

We are now ready for the jets. First make a "D" taper reamer (Fig. 10). The easy way is with a lathe grinder. Cut the taper with lathe running, and resetting to parallel, cut the "D" with the lathe stopped, otherwise it will have to be turned, filed and stoned to as fine a point as required, hardened and tempered, and if it is to be used for jets smaller than any drill available, the end must be ground off as in an ordinary "D" as used for squaring out the ends of holes after drilling. I am no authority on the best taper to

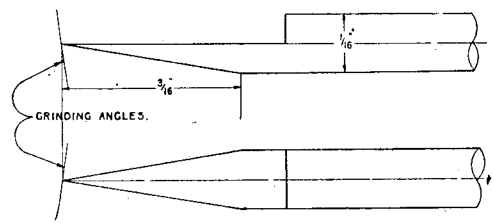


Fig. 10. *Jet reamer or boring tool*

obtain maximum acceleration and expansion, and only very precise tests could distinguish between the small variations permitted by other considerations. The shorter the taper the less the likelihood of breaking the fine tip. A suitable taper is on $\frac{1}{16}$-in. silver-steel from $\frac{1}{16}$ in. to 0.003 in. in $\frac{3}{16}$ in. length. This very small size will give a steam jet for the smallest practical steamship of about 18 in. length and 1 m.p.h. With a 5 ft. craft of hefty beam the 0.0135 in. of a number 80 drill should provide power for 12 m.p.h. and the tip of the reamer need be no smaller than the opening drill, but for such a large burner the reamer should have $\frac{1}{8}$ in. large diameter and the hole in the burner carrier should be the same. The relation between fuel and steam jets is approximately 5 to 1 by cross-sectional area.

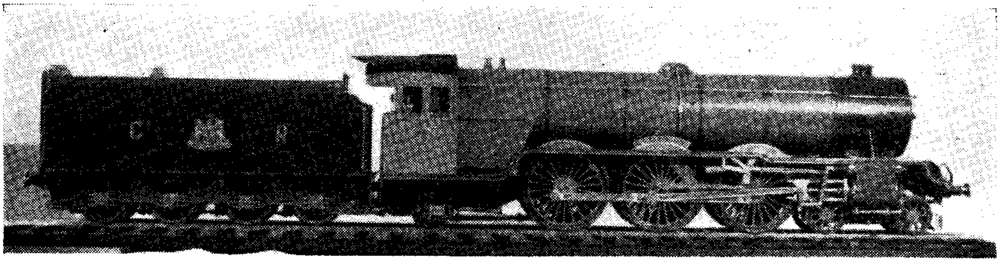
That is, a steam jet of 0.003 in. requires a fuel jet of 0.0067 in.; a steam jet of 0.006 in. requires a fuel jet of 0.0138 in.; a steam jet of 0.009 in. requires a fuel jet of 0.020 in.; and a steam jet of 0.0135 in. requires a fuel jet of 0.030 in.

These pairs will give approximately equal mixture strength from 5-100 lb. sq. in. steam pressure. If the fuel jet is smaller the flame will be rich at low outputs if satisfactory at the maximum; if large, the opposite result will be obtained. To match exactly, start with the fuel jet small and open out until matched. Taking it that the mixture will be adjusted correctly for the maximum desired output, a burner rich at the low range will probably give too much heat for stand-by purposes of merely maintaining pressure. On the other hand, a burner weak on the low range easily plops out if operated below 5 lb.

(*To be continued*)

The Keighley Exhibition 1952

by "Northerner"

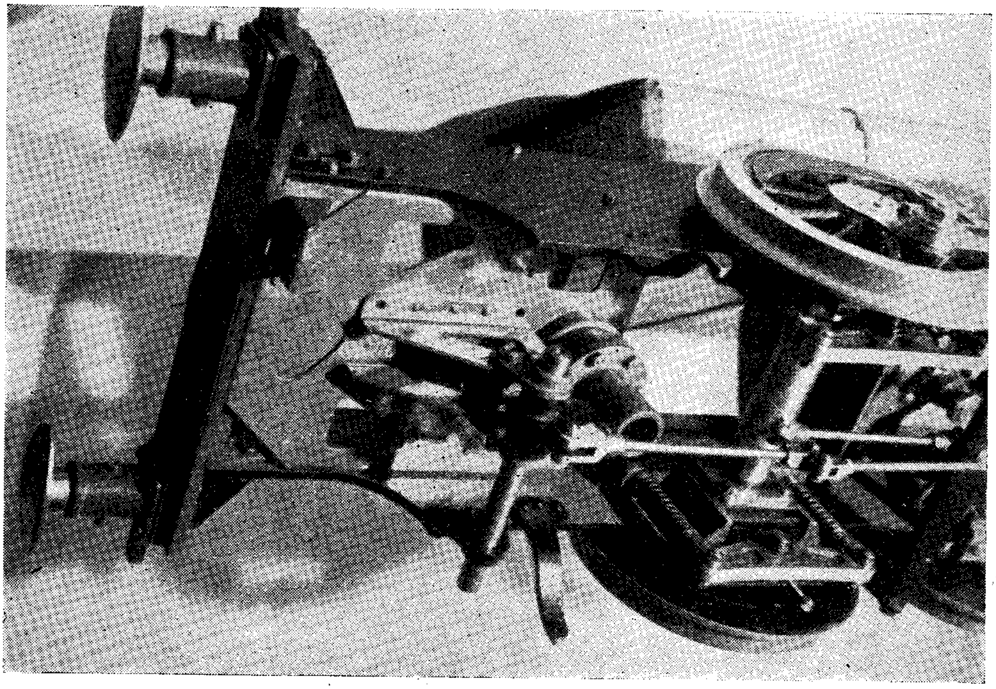


A beautifully-built Caledonian "Pacific" by Dr. T. Fletcher, of Colne. The coats-of-arms on the tender were real works-of-art

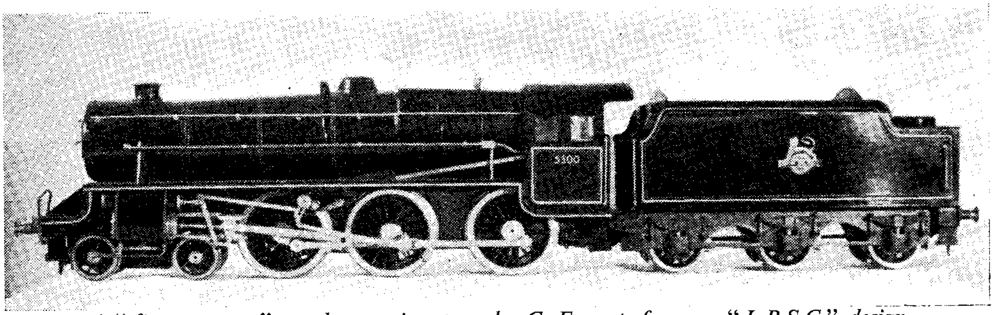
THE Keighley and District Model Engineering Society has only been in existence for a comparatively short period, but from the exhibition staged by the society recently, it is obvious that the members are not only good craftsmen, but keen, too. They were also fortunate in having the ready support of other societies in the North, so that the result was a really fine exhibition, well representing every branch of the hobby.

For example, the name of Dr. Fletcher, of Colne, is well known to readers of THE MODEL ENGINEER: his beautiful power-boats—the tug, the pilot cutter, and the steam-yacht—have all won high awards at the London exhibitions of recent years. They were all on view at Keighley, and with them was another model which showed Dr. Fletcher in a new light—that of locomotive builder. It was the fine "Caledonian" locomotive, which, built to $\frac{3}{4}$-in. scale, was just what one would have expected of a craftsman of his calibre.

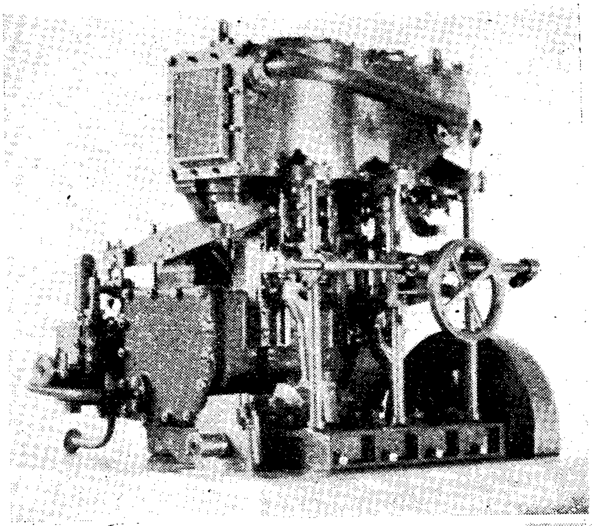
Another magnificent locomotive was "The Dalesman," built to $1\frac{1}{16}$-in. scale (5-in. gauge) by W. Lynch of the West Riding Small Locomotive Society. Of L.N.E. "Green Arrow" type, this



Some of the work that is not normally seen—the underneath detail of W. Whiteley's "Twin Sister"



A "first attempt"—and very nice, too—by C. Forrest, from an "L.B.S.C." design



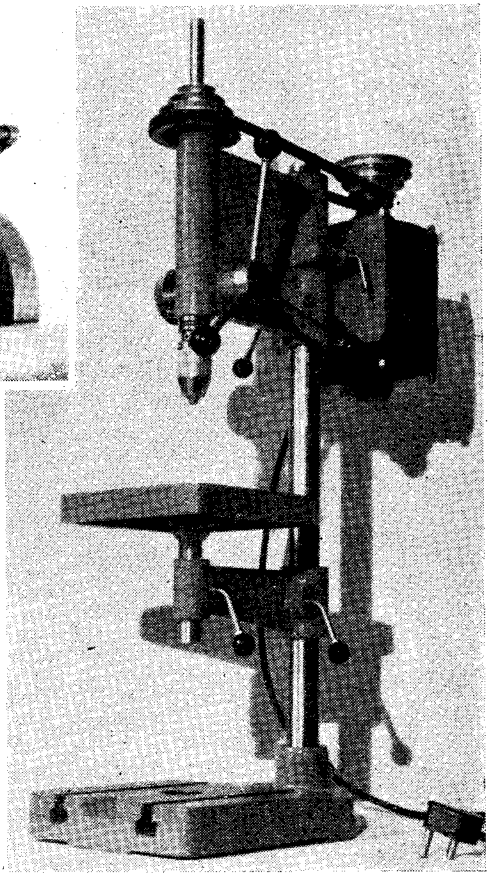
In building this compound condensing marine engine, H. Booth, of Bingley, is keeping to the high standard of craftsmanship of his previous work

engine had won the premier award at the National Rally and Trials held during the summer by the Birmingham S.M.E., and a photograph was displayed showing the locomotive actually hauling a load of 2 tons. Unfortunately I did not get a photograph of her myself.

"Twin Sisters"

The "Twin Sisters" locomotives are deservedly popular among Northern clubmen, and I have seen some excellent examples at various Northern venues. However, it can be said quite honestly that Bill Whiteley of the Keighley club, is in my opinion, making as good a job as any with his. This chassis won the Founder's Trophy last year, and if the rest of the locomotive comes up to the same standard, (which, knowing Bill, one can almost guarantee !), she'll be a good looker *and* a good worker when finished.

Still another fine locomotive was C. Forrest's $3\frac{1}{2}$-in. gauge L.M.S. Class V, to "L.B.S.C.'s" "Doris" design. I was told that this locomotive is a "first attempt," but certainly one would not have guessed this even on a close inspection. The painting was very good indeed, and the B.R. Lions on the tender were almost unbelievably real, although hand-painted.



Of excellent craftsmanship, the drilling-machine shown by the builder, R. V. Mitchell, of the home club, who also designed the machine and made the patterns, in addition to doing the machining and fitting. The finish was good, too

Machine Tools

Some grand machine tools are made in Yorkshire factories, and so they are in the smaller workshops, too. One of these was H. Gavin's lathe, which was awarded the Founder's Trophy for the best work in the exhibition. This is a sturdy machine of more or less orthodox design, of $4\frac{1}{2}$-in. centres, and has been built chiefly at model engineering classes held at the Keighley Technical College. Mr. Gavin is to be congratulated on his workmanship, the fruits of which will be with him in his hobby for many years to come

Another well-finished machine-tool was the 0-$\frac{1}{2}$ in. drilling-machine, which was built by R. V. Mitchell, of the Keighley Club. I understand that the builder did the designing and the pattern-making, as well as all the machining. Incidentally, I also noticed a neat chassis and boiler shell for a $\frac{1}{2}$-in. scale L.M.S. Pacific, being built by Mr. Mitchell.

Well-Known Models

The name of H. Booth of Bingley is well known to readers of THE MODEL ENGINEER, with his historical steam-engine models—remember his beam-engine a few months ago on the cover of THE MODEL ENGINEER? Several of his models were on show at Keighley, including the beam-engine, a low-type table-engine, a horizontal compound mill engine, and a single-cylinder horizontal engine.

However, I had not seen before his compound condensing marine engine, which is still under construction. This is to a design described in THE MODEL ENGINEER in 1922, and has cylinders $1\frac{3}{4}$ in. and 3 in. bore by 2 in. stroke. The crankshaft is $\frac{13}{16}$ in. diameter and 11 in. long; the condenser has 83 tubes $\frac{1}{4}$ in. diameter, and there are air, circulating, feed, and bilge pumps.

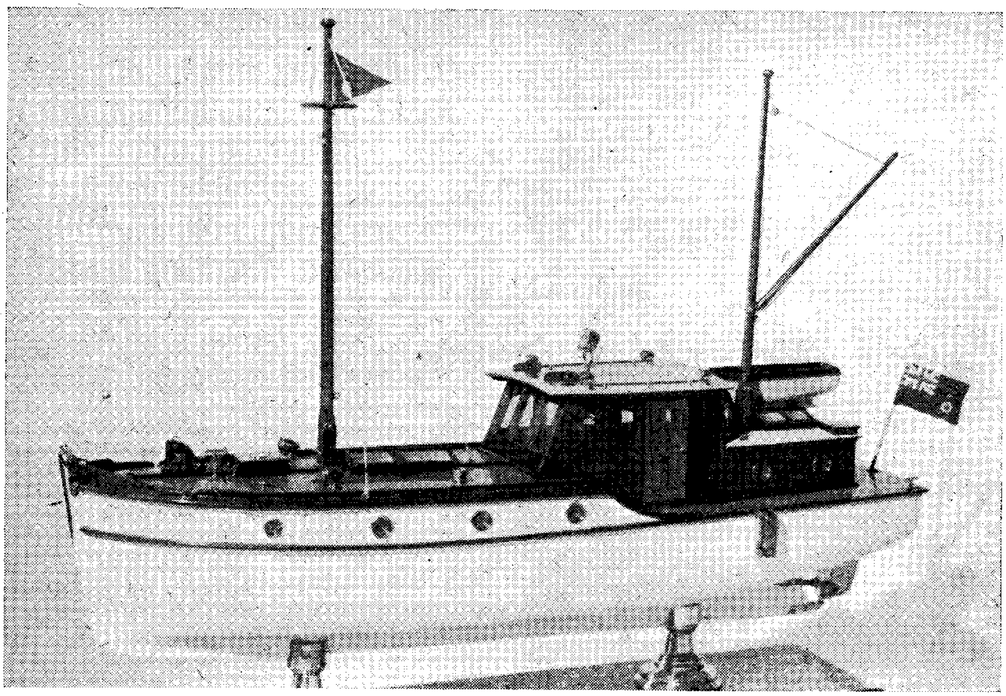
Incidentally, Mr. Booth also has launched out in the locomotive field (if that is not a contradiction of terms!), and his "Britannia" is not unworthy of his other models. To those who know the latter, 'nuff sed!

Power Boats

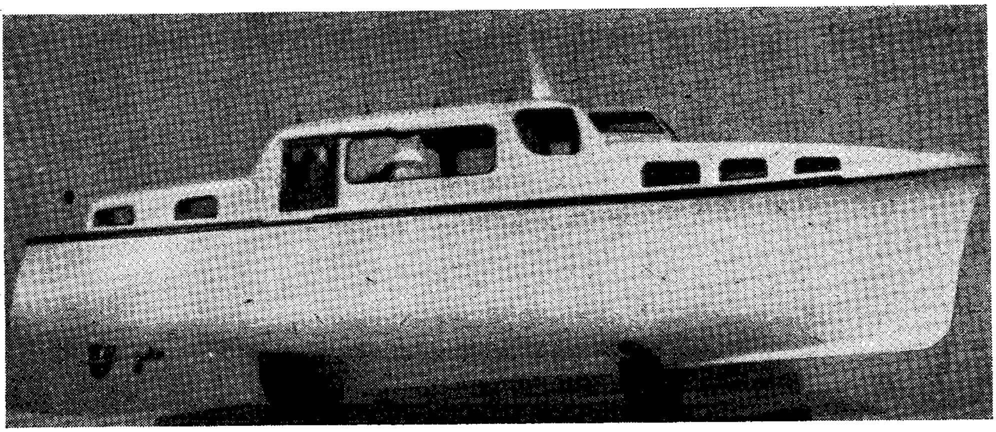
Apart from Dr. Fletcher's beautiful power-boats, previously mentioned, there were several other fine models in this class, and of them the judges awarded the Meeson Trophy to T. Luccock of the Bradford M.E.S. (This trophy is for the best engineering model in the amateur class.)

Mr. Luccock's model is of a Bridlington cabin-cruiser, to $\frac{1}{2}$-in. scale, and was built to drawings supplied by the builders of the prototype. The hull was carved from the solid, and is only 18 in. long. No power plant is fitted as yet.

All the detail is beautifully executed, and includes such cockpit fittings as dashboard with instruments, compass, and throttles. All lights work, and the searchlight, only $\frac{1}{2}$ in. diameter, dips, tilts, and rotates correctly. The builder mentioned to me that more than 1,800 hours were spent in building this delightful model.



Full of excellent detail, this delightful $\frac{1}{2}$-in. scale cabin-cruiser has occupied more than 1,800 hours of spare-time for T. Luccock, of Bradford



Another "first attempt" is this Walton cruiser, with planked hull, built by W. Panter, of the Keighley club

W. Panter, of the Keighley Society, had also chosen a cabin-cruiser, the prototype being built by the Walton Yacht Works Ltd. In this case the hull is planked, and a very sweet-lined hull it is too.

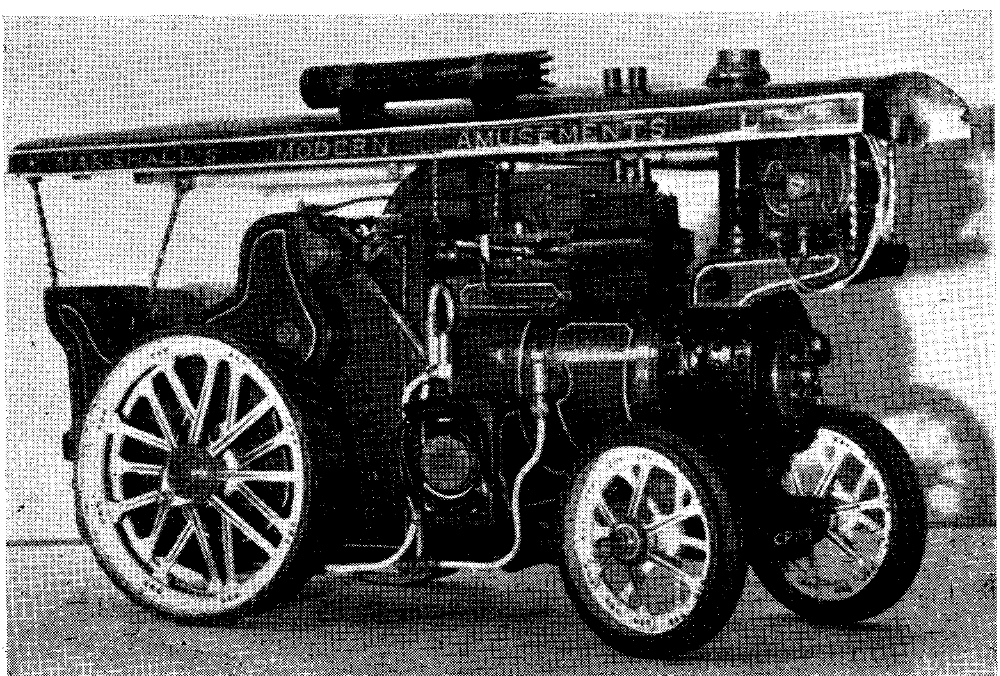
A considerable amount of the detail work has yet to be done, and again the power-unit is not yet fitted, but I am looking forward to seeing this boat once more when she really is completed. The builder is to be heartily congratulated on this, his first model.

Another neat cabin-cruiser, apparently of free-lance design (though one could be wrong !), was built by C. Forrest, whose locomotive we have already seen, but unfortunately I had to leave the exhibition in rather a hurry, and in the rush omitted to take any further notes concerning the model. My apologies to Mr. Forrest !

A Showman's Engine

The traction-engine was not well represented at Keighley, but D. W. Horsfall (of either the Bradford or Bingley society) exhibited a 1-in. scale

(*Continued on page* 812)

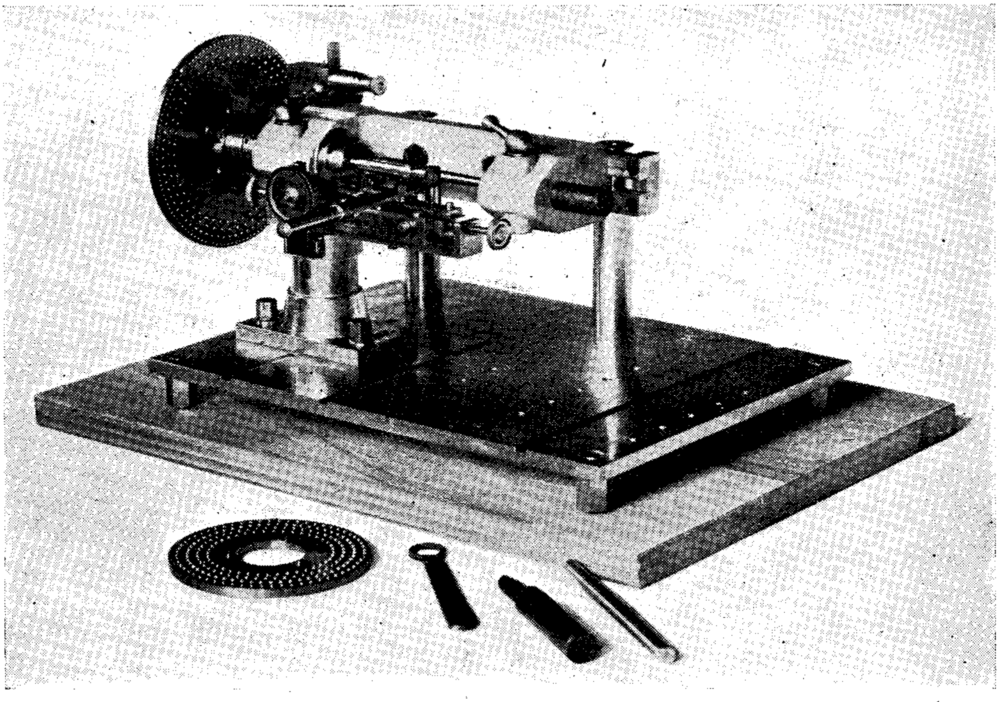


Although the model is somewhat "out" in proportion and detail, D. W. Horsfall gave pleasure to many people by showing his 1-in. scale showman's locomotive

A Dividing and Engraving Engine

by K. N. Harris

THIS piece of apparatus has been made for the specific purpose of dividing and engraving index dials and thimbles for feedscrews, angular bases for machine tools or accessories, protractors, indicators, or, in fact, any form or cylinder, disc or cone requiring such treatment.



Dividing engine set up for small work, mounted on mandrel between centres

Usually, much work is done (by the amateur) by means of various " rig-ups " in the lathe, and these often take longer to fix up than does the job itself to do. For years I had proceeded along such lines myself, much, I suppose, to my own discredit. Some time ago I had an awkward pair of feedscrew thimbles to divide and there seemed no simple way of achieving this by any normal rig-up, and in consequence I decided to do what I should have done years ago—make a piece of apparatus to do not only this job, but within broad limits anything of a similar nature ; the fitment illustrated is the result.

Basically, it consists of two units :—

(a) The dividing and indexing unit, and (b) the engraving head.

I had in my possession one of those excellent accessories, the Quickset dividing head, and I decided to utilise this for (a).

This entailed very considerable modifications, which, incidentally, had the secondary result of considerably extending the scope of the unit for its primary purpose of fine gear cutting, etc.

It should be made clear that the alterations and additions which I made in no way imply faulty design in the original unit. Far from it, for it is a first-class job at a most reasonable price. All the alterations I made could equally well be done by the makers, but that would probably entail doubling the price.

The standard apparatus is fitted with a $\frac{3}{8}$ in. capacity collet and drawbar. The latter was not hollow, and the first alteration was to bore this clean through 13/32 in. diameter.

The frame of the fitment is a one-piece job embodying both head and tailstocks in a single casting, the height of centres above bed being only $1\frac{1}{8}$ in. and this reduced for long work by the nuts used to bolt it to vertical slide or whatever other base might be necessary. The bolts were abolished and the holes countersunk to take $\frac{3}{8}$ in. screws.

It was obvious, however, that if $2\frac{1}{4}$ in. diameter was the largest work that could be tackled, the usefulness of the unit would be severely curtailed.

The next move was to make up a $\frac{5}{8}$ in. diameter

mandrel, a good fit in the tailstock, with its inner end reduced to $\frac{3}{8}$ in. diameter to meet the collet, and carrying at its outer end a light steel faceplate of about $4\frac{1}{2}$ in. diameter. The outer end of the mandrel was accurately bored down $\frac{3}{8}$ in. diameter for about 1 in. depth, with a continuation hole $\frac{1}{4}$ in. B.S.F. tapped for another $\frac{3}{8}$ in This was to take a centring mandrel or spigot for any job to be mounted on the faceplate This addition enabled work of a diameter quite unrestricted by the centres of the unit itself to be dealt with.

For most of the work likely to be done, plain dividing is adequate. Figures such as 10-20-25-40-50-100 on the metric side, and the octive series, obviously do not call for worn dividing gear.

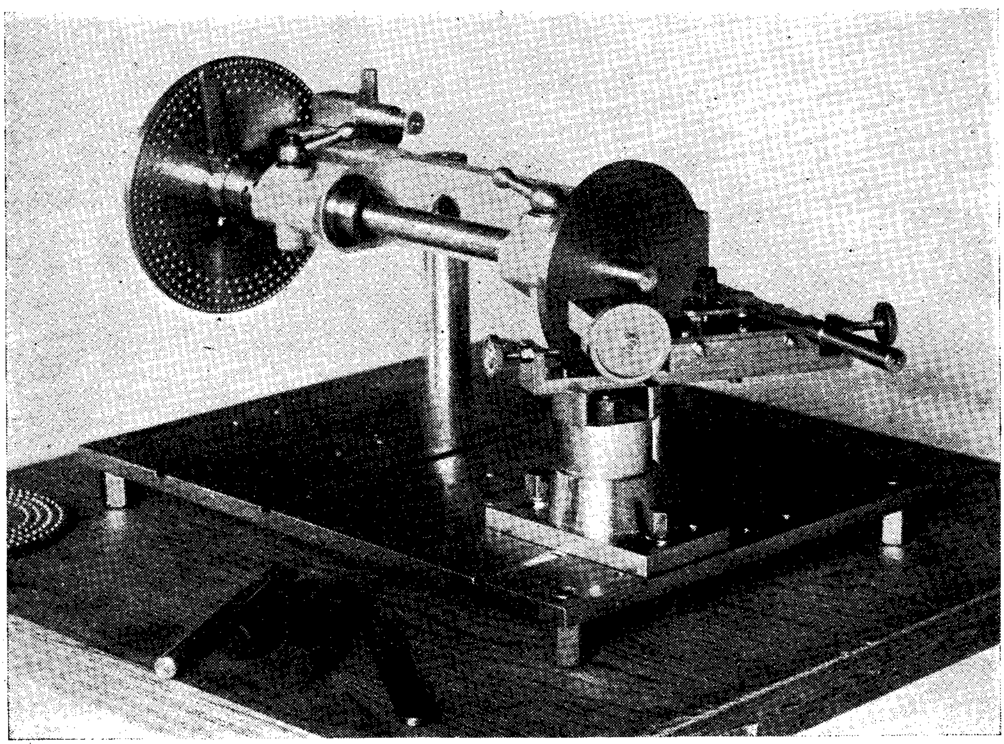
I, therefore, constructed a dividing plate, stop-plunger and setting arms, which could replace the standard worm and wormwheel supplied with the apparatus originally.

The dividing plate has four rows of holes, 120-72-50 and 48 and the block which carries the stop-plunger has four positions, each corresponding to a row of holes and located by a taper dowel pin. The block has a tenon locating in a milled slot in the bracket which carries it. The division plate is retained on the mandrel tail by two Allen socket-screws. This apparatus can be removed and the original worm dividing apparatus substituted in less than five minutes.

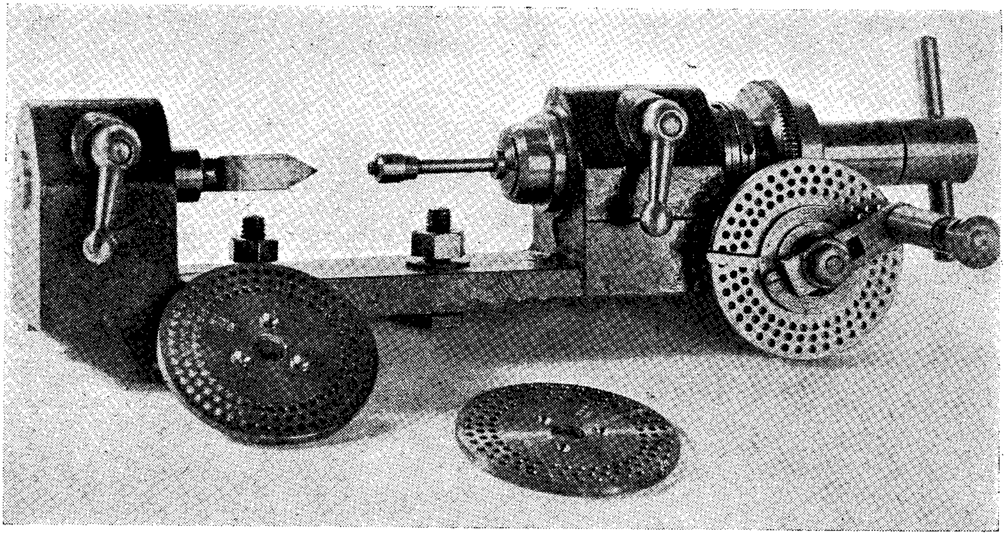
As can be seen from the photographs, the whole job is mounted on a substantial bed ($\frac{3}{8}$ in. steel plate) and the dividing unit is mounted on a pair of steel slide-rails, which allow for endways adjustment, the slide-rails themselves being mounted on two turned columns nutted beneath the bed. The height is such as to allow work up to 7 in. diameter to be mounted on the faceplate.

The baseplate was ground on the top side and three shallow grooves milled in it—one right across and the other two partly across. These are to locate the tenon on the engraving-head. A series of holes are drilled and tapped 0 B.A. to take the engraving-head holding-down screws.

The engraving-head is built up very largely from brass ; so far as the slides are concerned, this is of the hard rolled variety. The standard is in three parts—the rectangular base, the coned lower base which is angularly divided (actually done on the unit itself with a temporary packing-piece substituted) and the upper portion, which is suitably recessed to accommodate the holding-down nut and the slide base. The slides are of the square-edged type, much simpler to make than the " Vee " form ; the carriage has the cutter-head mounted on it. The cutter-head holds the " Vee "-pointed cutter which is adjustable by a 40 t.p.i. screw, by means of the small hand-wheel. The latter is divided into 25 to give 1/1,000 in. advance or withdrawal of the tool per division.



Dividing engine set up for large diameter bevel-faced disc



The "Quickset" dividing unit, as supplied

An index pointer is provided. Stop screws are provided at the ends of the slide base to limit its travel to the required amount; they are fitted with lock-nuts.

The carriage is operated by a small hand lever through suitable linkage.

The head can be swivelled through a complete circle and there are four zero index points on the rectangular base.

The main base itself has four feet about ⅜ in. deep which are drilled ¼ in. to allow for it to be screwed down to a bench or baseboard.

There is a spare division plate for direct dividing, and a couple I have made for the worm apparatus, in addition to the three supplied by the makers. All the plates are in hard brass.

The dividing was done on a worm-driven horizontal rotary table, for which I had to make a special index to obtain my 50 row of holes.

The finish of the baseplate, standards and slide frame, and of the engraving-head is nickel plate whilst the new parts for the dividing unit are natural metal finish. The dividing unit frame was carefully filed up, filled, rubbed down and is finished in light grey paint.

A special ring spanner was made to deal with the nut which locks the swivelling-head of the engraving nut, whilst additional centres and a tommy bar for the drawbar were also made.

All nuts, set-screws, etc., are case-hardened. The apparatus is quickly set up and very handy in use, and has already done a very wide variety of work. Though obviously having only a limited appeal, for those who have much indexing to do, something of this nature is very much a worthwhile proposition.

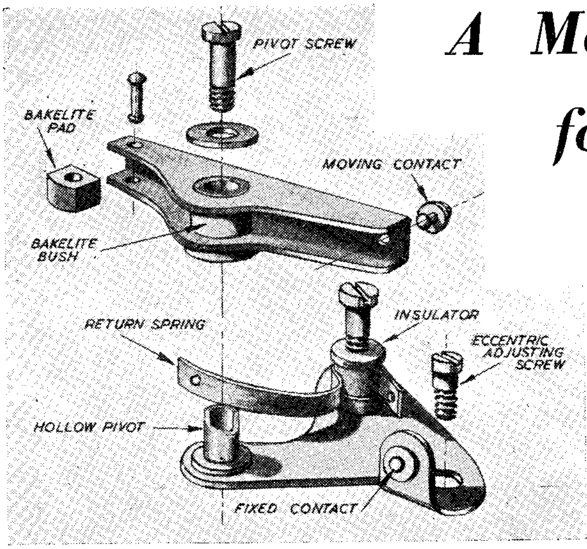
The Keighley Exhibition

(*Continued from page* 809)

Showman's Road locomotive. This engine purported to be to Foster design, but it would be more accurate to say that it possesses certain Foster characteristics—certainly much of the design is not Foster at all. To give but two examples, the pump is in the wrong position (and should be driven through reduction-gearing), and Fosters fitted trunk-guides, not slide-bars. Further, in some respects the model was out of proportion, as witness the over-fat boiler barrel and the too-thin chimney; the double high-pressure cylinders, too, might easily have been disguised as compound.

Nevertheless, Mr. Horsfall must have had many hours of enjoyment in building his model, and will doubtless have many more in running her. She certainly proved attractive to the general public, as a showman's engine invariably does.

In fact, the whole exhibition was very attractive, not only to the general public, but also to the more discerning model engineer. The Keighley Society may only be young in years, but it is evidently a very thriving youngster, and the energy and enthusiasm of some of its members might well be a lesson to some of the more apathetic members of larger and older societies!



A Magneto for the "Busy Bee"

An entirely new design for a flywheel magneto-generator, suitable for all types of small power engines

by Edgar T. Westbury

THE contact-breaker assembly constitutes a complete self-contained unit, having a bracket or mounting plate carrying the stationary contact, and arranged to be adjustably mounted on the magneto backplate. A fixed pillar on this component forms a pivot for the rocker arm, which is insulated from it by a bakelite bush, and the return spring, riveted to the rocker, is also insulated from the bracket, and serves as a flexible conductor to convey low-tension current to the moving contact. The assembly is located in such a position that the bakelite pad on the heel of the rocker rests on the cam surface of the flywheel hub, and is pressed against it by the return spring.

Mounting Plate

This is made in mild-steel plate, $\frac{1}{16}$ in. thick (or 16-gauge) and has a lug bent up at right angles to carry the contact. In marking out, it is advisable to allow a little extra length for the lug, as the bend may not come out to exact dimensions, however carefully one works; and it is also best to mark out and drill the hole for the contact rivet after bending. To avoid possible risk of fracture at the bend, a slight radius should be allowed, and this can be done by using a bending block made from flat steel bar, with one edge smoothly rounded off. Clamp the plate and the block in the vice, with the line of the bend just showing, and form the bend with a wooden or hide mallet. The position of the hole can then be measured from the top surface of the plate, and the top radius of the lug struck from this centre.

The pivot pillar is turned from mild-steel, with a large seating collar, and a spigot to rivet into the plate as shown, the underside of the plate being slightly countersunk, so that the riveting can be filed off flush. Use a block with a 7/32 in. hole drilled in it, to support the *collar* while riveting, so as to avoid risk of damaging the surface of the pillar or the internal hole. Incidentally, if the magneto should be required to run in the reverse direction (i.e., clockwise) it is advisable to make the assembly "left-handed," and change over its position on the magneto backplate.

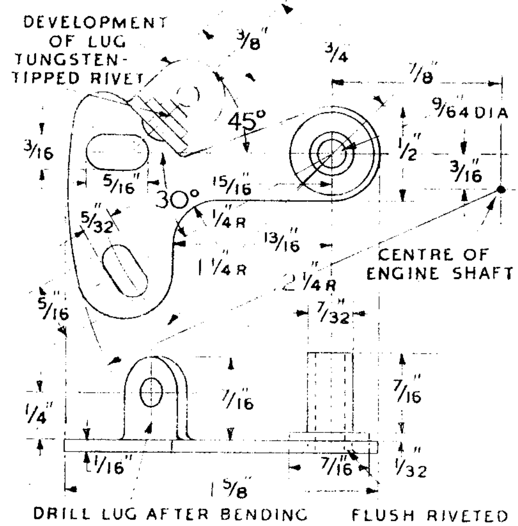
Rocker Arm

The material in this case also is mild-steel, but the thickness is 1/32 in. (or 20-gauge); a piece of the sheet steel used for the laminations may be found quite suitable. It is bent to channel section over a piece of $\frac{1}{4}$ in. flat mild-steel, both edges of which should have the corners slightly rounded off to avoid a dead sharp bend. After marking out and drilling the holes, the edges of the channel may be filed to the contour shown, care being taken to avoid distorting the metal in the process.

Both the bush and the pad should be made of a fine-texture laminated fabric bakelite composition, such as Tufnol or Paxolin. The bush should be made a fairly tight press fit in the rocker, and an *easy* working fit on the pillar. It is advisable to make the pad so that the plane of the laminations is at right angles to the rubbing surface, as this gives maximum resistance to wear; when fixing it in place with the single $\frac{1}{16}$ in. rivet, the latter should be an easy fit in the hole, to avoid risk of bursting the bakelite.

Try the rocker on its pivot to check up the correct alignment of the contacts; it may possibly be found advisable to adjust the thickness of the collar on the pivot bush to get them vertically in line. The radial position on the rocker, relative to the pivot position, may be correctly located by placing a distance piece of suitable thickness (to allow for the contact rivet dimensions) between the rocker and the lug of the mounting plate, and drilling through from the hole in the lug.

Continued from page 737, "M.E.," December 4, 1952.



MOUNTING PLATE 1 OFF M.S.

The size of the hole, in each case, will depend on the shank diameter of the contact rivet. Suitable rivets, having a welded-on tungsten tip, are obtainable in various sizes from ignition equipment specialists; the size most suitable in this case is that having a tip face of about $\frac{1}{8}$ in. or 3 mm. diameter. Care must be taken not to damage the tips in riveting; they should be supported on a copper or aluminium block, and not hammered more than is necessary, but a firm hold is essential to avoid risk of imperfect contact.

Return Spring

This should preferably be made from annealed spring steel, and afterwards hardened and tempered, as fully-tempered steel cannot be bent to the shape shown. If, however, this is found difficult, it is permissible to use "half-hard" steel, which is capable of being bent, drilled, and used without further treatment; but in this case the thickness of the material should be increased to 0.020 in. to be on the safe side. The spring should be firmly riveted to the rocker arm, as shown, and a hole is provided in the free end, to take a 6-B.A. bolt for connecting up the l.t. lead to the coil.

Adjusting Screw

For the purpose of adjusting the contact clearance, a screw is provided having an eccentric collar under the head, to fit the slot in the mounting plate, adjacent to the fixed contact. The exact amount of eccentricity is not highly important, and the eccentric can be formed, after turning and screwing the shank, by setting the work over in the four-jaw chuck, or by inserting a slip of packing in one of the jaws of the self-centring chuck. The other two screws call for little comment; ordinary 4-B.A. screws could be used, but the larger and flatter heads shown are an advantage; all three screws fit tapped holes in the magneto backplate.

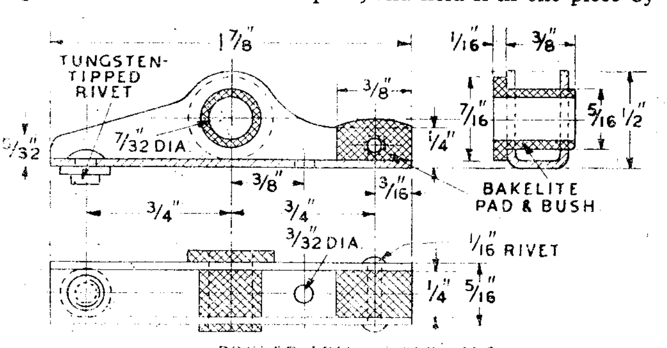
The insulating bush can be made from laminated bakelite, as described above, or vulcanised fibre. It acts not only as an l.t. insulator, but also as a clamping bush, so it must be mechanically sound. The spring is hooked round it, but is not positively fixed to it in any way; the waisted part of the bush, however, provides side location to prevent the spring swivelling on its fixing rivet and possibly "earthing" against the mounting plate.

The assembly drawing shows how the complete breaker is located, relative to the magneto shaft centre. It is best first to mark the position of the pivot, drill and tap the hole, and temporarily clamp the assembly in place, with the magneto backplate mounted on the engine (or temporary test mounting) and the hub on the shaft. Turn the hub so that the rocker pad rests on the concentric surface, and adjust the contact clearance by swinging the mounting plate around its pivot; correct clearance should be 0.010 in. It is now possible to mark the position of the adjusting screw and locking screws through their respective slots; they should be in the centre in each case, to allow latitude of adjustment both ways.

To adjust clearance at any time, it is necessary only to ease off the pivot and locking screws, and turn the eccentric screw as required, to vary the position of the fixed contact relative to that of the rocker; then re-lock the assembly by tightening both the main screws. This, of course, is the method adopted on most modern forms of contact breakers, and will readily be understood by all users.

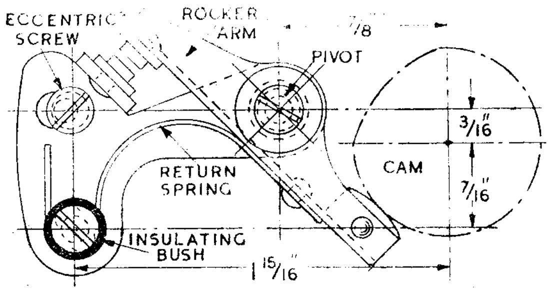
Coil Winding

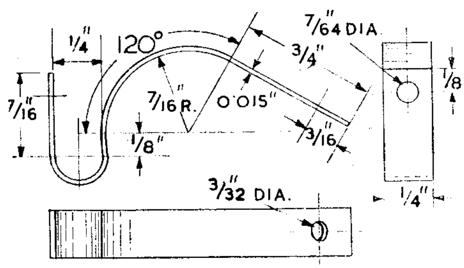
I do not propose to devote a great deal of space to this subject, as it has been dealt with in minute detail in my series of articles on ignition equipment, and further recorded in the M.E. handbook of the same name. The l.t. stator coil is wound with approximately 500 turns of No. 24 gauge enamel-covered wire; quite an easy job, which could be done by hand if necessary, though it is, of course, desirable to detach the stator from the backplate, and hold it in one piece by



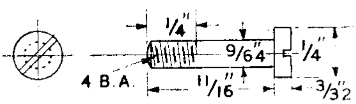
ROCKER ARM 1 OFF M.S.

two temporary bolts. After rounding off the corners, a layer of stout paper should be wound on the core, and cemented in place with any non-aqueous and chemically inert adhesive; it is also advisable to fix a paper disc against the shoulders of the core to prevent risk of chafing the wire while it is being wound. Secure the beginning of the first layer with a strip of adhesive tape, or by tying with cotton, to avoid the possibility of it being pulled out afterwards. When the first layer has been wound, the second may follow it straight away if desired, but as there is plenty of room here, I prefer to interleave with a layer of paper, which helps to support the coil mechanically, and also improves insulation. It is, of course, desirable to wind the wire as evenly and closely as possible, to ensure a neat winding and avoid "slipped turns," which are always a nuisance, and may become a menace. The end of the winding should be secured, and the outside of the coil may be well varnished, taped, or otherwise protected; both ends of the wire should have soldered tags, one being "earthed" under the head of the adjacent fixing screw, and the other connected to the l.t. terminal bolt. (If one objects to an "earth return" circuit for the lighting, *both* ends can be connected to insulated terminals, as an alternative.)

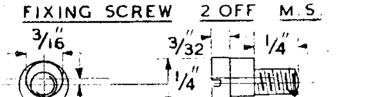




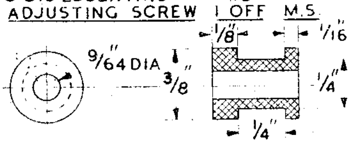
ROCKER SPRING 1 OFF SPRING STEEL



FIXING SCREW 2 OFF M.S.



O·O15" ECCENTRIC ADJUSTING SCREW 1 OFF M.S.



INSULATING BUSH 1 OFF BAKELITE

The ignition coil is a rather more difficult proposition; it is possible to wind it in the lathe if care is taken, but it is desirable to fix up some method of counting the turns, and the stator must be mounted to run as truly as possible, either between centres, or on some simple form of jig. Rounding off the corners of the core is very important here, and a layer of paper should be put on as before. The primary consists of three layers of No. 24 gauge enamel-covered wire (about 180-200 turns), and the procedure is much the same as for the l.t. coil, except that as space is very important, interleaving must be dispensed with. It is a very good policy to test the primary winding before proceeding further, because, if there should happen to be a fault, or an "earth" to the core, it is much better to correct it now than to have to scrap the coil after the tedious job of winding the secondary is completed. Any simple test galvanometer, or even a battery and torch bulb, may be used for this check-up. A layer of paper about 0.005 in. thick should be cemented on the primary to form a smooth, even foundation for the fine secondary winding, which consists of approximately 12,000 turns of No. 44 gauge enamel-covered wire, wound in about 40 layers, each interleaved with paper, 0.002 in. thick. The inner end of the secondary is connected, by soldering, to the outer end of the primary.

Very careful handling is necessary in winding this fine wire, and it is advisable to arrange an automatic feed to ensure that it is laid evenly without overriding turns. The size of No. 44 gauge enamelled wire, over the enamel covering, is slightly under 0.004 in., but it is advisable to set the feed a little coarser, say, 0.005 in. per turn, so that a little space is allowed between turns. There should be a $\frac{1}{4}$ in. margin left at the ends of each layer of wire so that the actual winding is only $1\frac{1}{2}$ in. long, but the paper interleaving should fill the full width of the core space, if anything a little on the tight side.

The outer end of the wire should be soldered to a strip of brass or copper foil, which is led out, through further layers of paper, to emerge at a suitable location for the h.t. spring contact when assembled. On no account allow the foil to make a complete *closed* turn, as this would be equivalent to a shorted transformer coil, and destroy efficiency. The entire coil, after a continuity check, should now be thoroughly impregnated with a high-resistance insulating varnish, as described in the handbook referred to above. This is the most important job of all in producing an efficient and permanently reliable coil.

(To be continued